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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

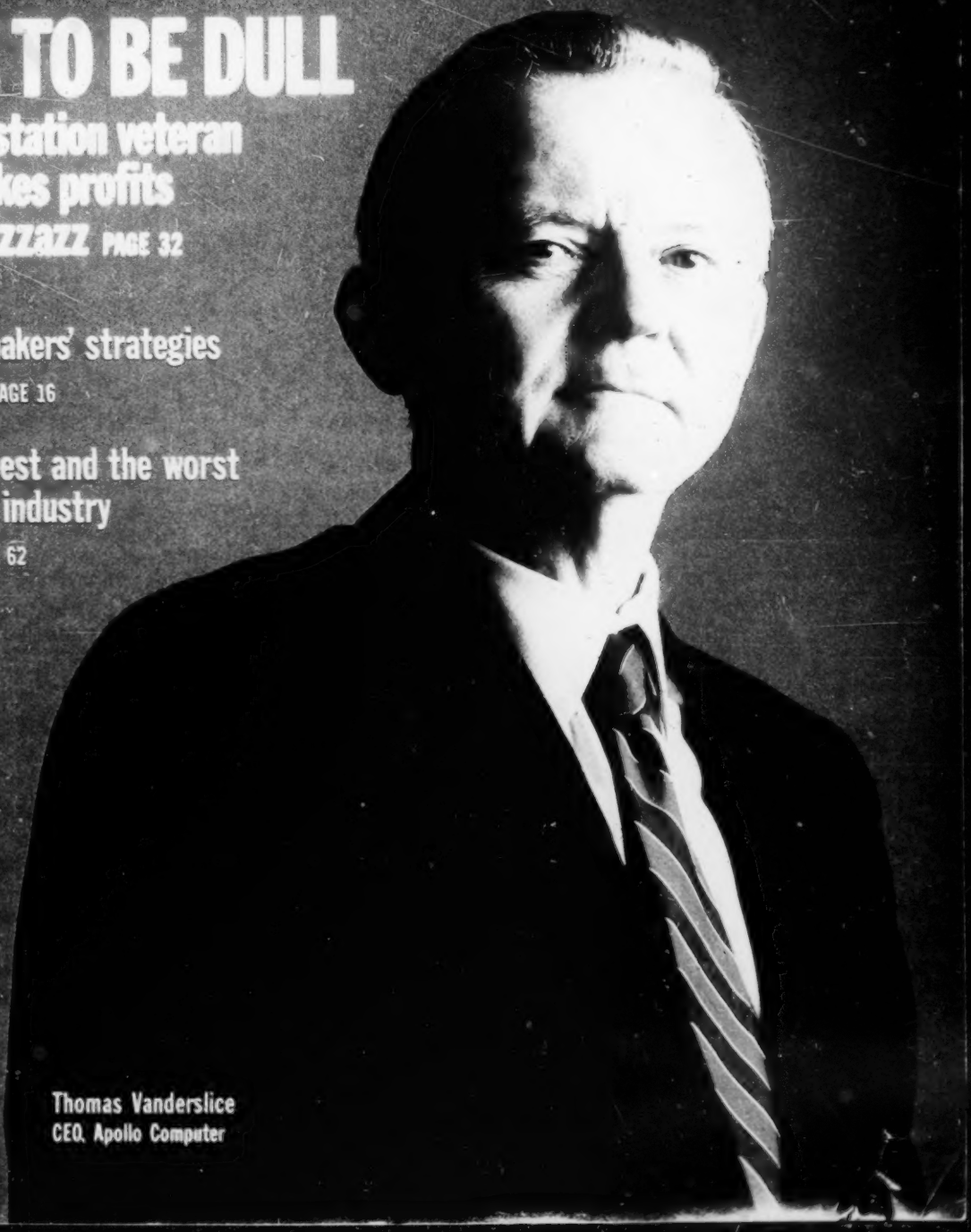
JUNE 15, 1988

DARE TO BE DULL

How workstation veteran Apollo makes profits without pizzazz PAGE 32

Small chip makers' strategies for Europe PAGE 16

Rating the best and the worst electronics-industry mergers PAGE 62



Thomas Vanderslice
CEO, Apollo Computer

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES WORLDWIDE

VOL. 14, NO. 12 JUNE 15, 1988

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Pass the pizzazz, please

As our cover plainly states, Apollo Computer chairman Tom Vanderslice has a probiem. Apollo is as bold and brash as any start-up computer company that's come along in the past five years. But possibly because Tom, a GTE veteran, is a low-key kind of guy, the firm never gets as much press coverage as its West Coast workstation rival and market leader, Sun Microsystems.

To rectify that situation, we asked associate editor Beth Karlin to visit Apollo. The company is doing just fine, thank you, we learned. But it still has an image problem to overcome. More often than not, the word "stodgy" is the one that comes to mind.

Take our cover photo. When we asked the chairman, who is a jogger of sorts, if he wouldn't mind being photographed in the company gym, he respectfully declined. He didn't give us any reasons for turning down our suggestion — it's not because he's not in shape, because he is —but we suspect that chairman Vanderslice has an image of himself and his company, and that image doesn't involve sweatbands.

So be it. Business is won or lost in the marketplace, not on a Nautilus machine. But in an industry where image is, if not everything, at least 90% of everything, it sometimes pays to be a little daring.

Vanderslice: This is as hip as we get

That's our opinion anyway. In any event, dull or not, Apollo — at $550 million in sales last year — is a force to be reckoned with in the workstation arena. We highly recommend our story.

AL FURST

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VBPA ABP

SMT snapshot: U.S. electronics assembly lags

Since 1983, first-pass yields in U.S. electronics assembly are up 10% and leadtimes have halved. But there's a ways to go

BY CHARLES-HENRI MANGIN

Charles-Henri Mangin is president of Ceeris International Inc., a consulting firm in Old Lyme, Conn., which specializes in electronics assembly. Ceeris has been monitoring assembly performance in the United States since 1983

Based on our recent detailed analysis of 50 large electronic factories in the United States, which collectively assemble approximately 15% of the boards in this country, we can conclude that the U.S. electronics assembly industry still has a ways to go before it catches up with foreign operations. Our analysis focused on management issues such as:

- assembly resources utilization,
- level of work-in-process,
- first-pass yields,
- cost of assembly,
- leadtime for assembly,
- introduction of surface mount designs, and
- new design introduction rate.

The 50 assembly lines we studied assembled a total of 73.3 million boards per year and 11.5 billion components, of which 36% were surface mount components.

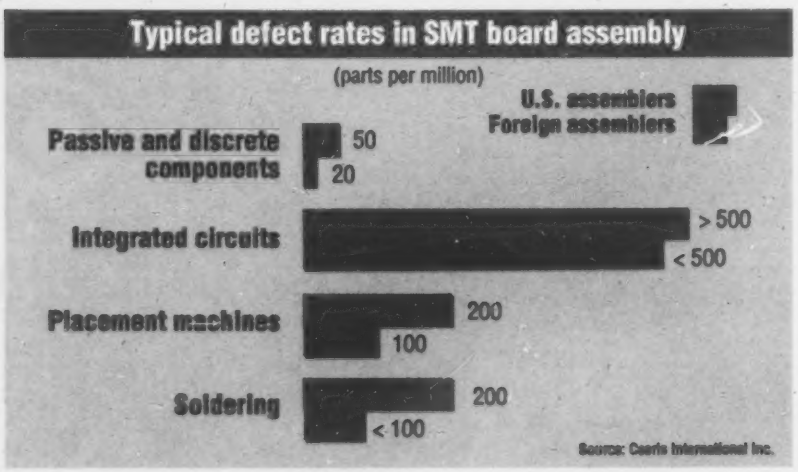
Unfortunately, manufacturing is still not the major concern for most high-level managers in the United States, thus the scarcity of statistics that managers can use to compare their own assembly operation with other operations. They regard it as a minor concern because manufacturing cost only amounts to a small percentage of a product's market price. This is shortsighted; if a new, reliable product is to be introduced rapidly, you must pay equal attention to design, marketing and manufacturing.

Our most successful foreign competitors are vertically integrated and consider manufacturing as important as design and marketing. Moreover, the role of manufacturing will become more important as digital products (cellular telephones, fax machines, laptop computers, etc.) become more consumer oriented and, therefore, more price-driven. Fortunately, with companies such as Digital Equipment Corp. and IBM now emphasizing design for production capabilities and in-house process development, good manufacturing practices are staging a comeback in the United States.

Hope ahead

Two out of every three operations in our study show ample room for improvement. Assembly subcontractors are the best performers. Captive operations, on the other hand, are lagging, primarily in just-in-time assembly, integrated assembly systems and standardization for manufacturability. Also, management performance is lowest where board mix is highest. When the types of different boards per year exceed 300, assembly becomes almost unmanageable. This is a big problem because, to be competitive, American electronics manufacturers must learn how to handle high-mix, small-lot manufacturing to maintain a competitive edge. High mix requires flexible assembly resources, which are both capital- and know-how intensive. Managing numerous small lots is also information- and quality-intensive.

But there is hope. Since Ceeris performed its first industry-wide analysis of electronics assembly in 1983, first-pass yields have increased by an average of 10%; leadtimes have been halved; and the overall level of automation has increased by almost 50%. This shows that U.S. electronics assembly is pointed in the right direction, but it has not yet reached the level we deem necessary for it to outperform its most successful foreign competitors. □



Oops! U.S. assemblers get the boo-boo prize

C Alterio

Little chip makers find novel ways to approach European markets

The smaller semiconductor houses aren't waiting to make it big in the States before tackling Europe's markets. Their secret: independent local operations

For most of the big broad-line U.S. semiconductor suppliers, and for many years, the U.S. market was big enough and exciting enough to absorb most of their attentions. Overseas opportunities did beckon, but generally they did not beckon brightly enough to merit major strategic change. And setting up facilities to serve them adequately was by no means cheap. So as a rule, the major merchant chip vendors rarely thought about overseas operations until they had become established successes at home.

But several of the semiconductor start-ups — companies like Sierra Semiconductor Corp., Xicor and Performance Semiconductor Corp.—are thinking differently, particularly with regard to Europe. Eager to tap into global opportunities with their narrower product offerings, they are setting up European facilities long before claiming fame and fortune in the United States.

These companies are drawn by a European semiconductor market that, according to the Semiconductor Industry Association, was worth $6.07 billion last year and will reach $6.3 billion this year. They are also particularly drawn by Europe's growing strength in custom chips, and believe in finding new ways to do business there —ways that should be instructive to many other small electronics firms as Europe gears up to become one homogenous trading market by 1992.

The younger chip vendors are thinking differently because business circumstances have changed considerably in recent years. The U.S. semiconductor market has been through its most severe slump ever and is more fragmented than before — factors that encourage vendors to look outward at markets, such as Europe, which may have been slow-growing but which have also been steady. Additionally, Europe has shown strong receptiveness to American semiconductor technology as its own edge has dulled, and it has proved able to come up with the funds that can help U.S. firms set up shop there.

Among the methods the small fry are using to gain a European foothold are: raising capital on local markets; finding European venture-capital partners; and buying local production facilities. For many, Europe is beginning to provide a generous slice of their sales, as well as adding new dimensions to their product and design-engineering expertise.

Probably the most successful company to have exploited this model was LSI Logic Corp., the Milpitas, California-based ASIC manufacturer. LSI expects to achieve more than $50 million in revenue from Europe this year; more than 30% of its total revenue in 1987 came from non-U.S. markets.

The company saw early in its genesis that peculiarities of the ASIC market dictated autonomous affiliates in Europe and Japan. "We recognized those markets [would] not be appropriately served without being close to the customer," says Robert Blair, LSI's vice president for sales and marketing.

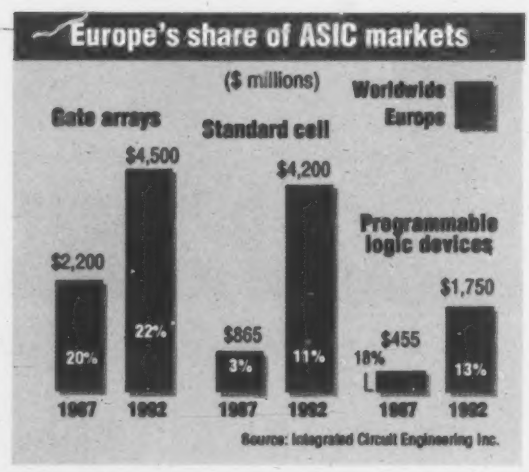
High-tech appetite

"There are really two parts to that mechanism," Blair explains. "First, we realized that equity to fund those affiliate companies could be raised in Europe and Japan. There was an appetite for high technology and a lot of money waiting for investment, but we had to offer stock priced in the local currency."

That realization was crucial. By using local currencies, LSI was able to avoid the damaging pitfalls of accounting for a fluctuating dollar exchange rate. This meant the affiliates' growth would not be an expensive burden upon the parent. "The companies had to be essentially self-financing; we didn't want to beg, borrow or steal from the parent for a market that was probably not fully understood," says Blair.

And second, was the willingness to relinquish total control over a subsidiary as the price for that flexibility. "Most companies struggle with that," Blair remarks.

LSI Logic currently has two



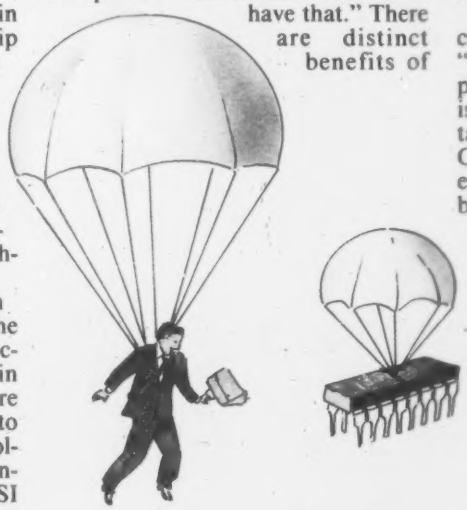
European lure: fast-growing ASIC sectors

semiconductor plants in Europe: one in West Germany, which is the firm's principal high pin-count plastic packaging plant, and an IC fab in England. Both factories have been partially funded by a local government grant and through finances which LSI Logic Europe raised in 1984.

In both cases the resident skills and resources exploit European strengths and are not duplicated elsewhere in LSI Logic's empire. Witness the chip plant in England. LSI Logic was quick to recognize the potential of a mixed analog/digital technology being developed by the British firm STC Plc. LSI Logic came to an arrangement with STC whereby it took over a new 6-inch wafer fab just completed by STC and obtained rights to the mixed-signal technology.

"We exploited specific European skills there," explains Blair. "At the time we wanted a mixed-signal process, there was no appetite for one in the U.S. But now there is a lot more talk about it so the U.S. is going to be a major customer of the technology." So Europe has become a "center of excellence" within the LSI Logic empire, exporting its particular technologies to the United States and Japan.

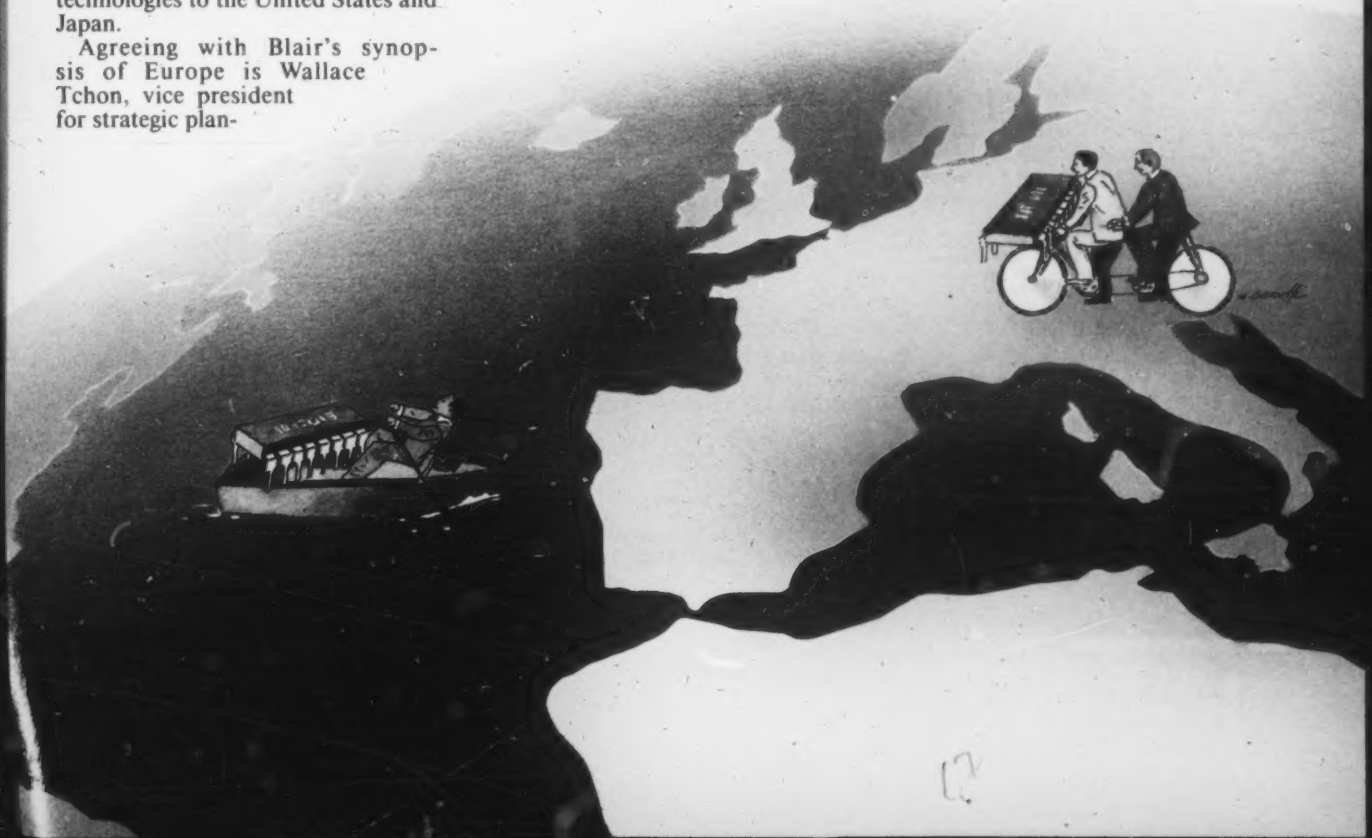
Agreeing with Blair's synopsis of Europe is Wallace Tchon, vice president for strategic planning at Xicor, a Milpitas-based manufacturer of EEPROMs. "It has always been an important part of our business; we also worked with the Europeans from early on in Xicor's life." About 20% of Xicor's revenue derives from Europe. Consequently, Tchon believes a strong European flavor pervades Xicor and a "lot of companies here in the U.S. don't have that." There are distinct benefits of such a relationship, he says.



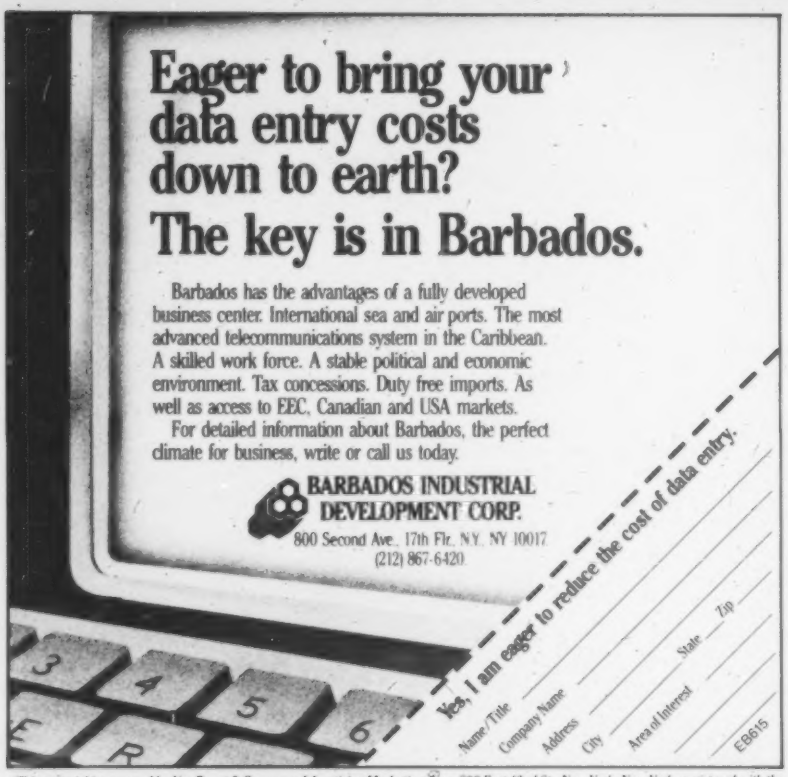
For instance, European customers display subtly different characteristics. "We tend to work with much longer relationships and deal with people that have longer horizons." Tchon says. That means Xicor gets a much better idea of each company's needs, which, in turn, can be translated into new products.

Xicor does not have a wafer fabrication plant in Europe, but it's a "matter we regularly look into," explains Tchon. The decision, he says, is a question of juggling fundamentals such as the European Economic Community's import taxes, the dollar exchange rate and the volume of business generated within Europe.

Four-year-old Sierra Semiconductor is also doing well with the Dutch operation it set up a year ago. With substantial equity funding from a Dutch venture-capital company — MIP Equity Fund — and with grants and loans from local government in Holland, the design and distribution center should return 15% of Sierra's sales this year, up from 5% of its $25 million revenue in 1987, accord-



Andrea Baruffi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ing to president James Diller. He expects the operation to contribute up to 25% of the firm's total revenue in the next couple of years. "If you don't move offshore today, you've got offshore companies coming to you," adds Diller.

Do not dilute

Diller stresses that it is important to set up a facility that does not prove a dilution or diversion to the U.S. operations. Peter Hillen, director for strategic marketing at International Microelectronic Products, a San Jose-based custom MOS chip maker, adds that a European presence makes it much easier to win in local markets. "Everybody likes to do business with people who smoke the same brand of cigarettes they do. In European minds, there is a distinct difference between a division of an American company and a separate European company with ties to an American company."

Hillen, whose company owns 40% of the design and marketing facility it established last year in England, adds that Europe becomes increasingly important as U.S. systems houses with European facilities, like Apple Computer Inc., increasingly seek local semiconductor suppliers.

Joseph Rothstein, international sales and marketing manager for Performance Semiconductor, a Sunnyvale, California-based specialist in high-speed static RAMs and microprocessors, believes he is clear about European factory needs. He feels his company will need a wafer plant in Europe within the "next two to three years."

Performance has its own special requirements for an IC plant in Europe over and above merely producing chips there: it has a focus on military circuits such as the 1750A processor chip set which has become a U.S. military avionics standard. If that product takes off in Europe, performance would ultimately have to adopt all the local military standards prevalent throughout Europe. "That would be one good reason to build a plant," Rothstein says.

"We would need to serve the military markets as closely as we can and be physically close to our customers. And in our commercial products, I can see the trade running back across the Atlantic," he adds.

SIMON PARRY

Apollo's CEO has a simple message: Slow and steady wins the customers — and the profits. But can a workstation maker pass up pizzazz in times like these?

The Vanderslice vision: Less pizzazz, more profits

BY BETH KARLIN

Thomas A. Vanderslice has an image problem. Industry analysts, reporters and even some customers accuse the chairman and chief executive of Apollo Computer Inc. of being a bit, well, stodgy. In a market that has produced entrepreneurial megastars like Sun Microsystems Inc.'s CEO Scott McNealy, Vanderslice — with his pinstripes and low-key demeanor — sometimes seems to blend into the background.

"He could do with some pizzazz," says Laura Conigliaro, an industry analyst with Prudential-Bache Securities Inc. "Image can make a great deal of difference to investors and customers." Especially when you're competing with a master of promotion like McNealy. "Sun clearly has captured the emotional high ground," says Apollo's largest — and still loyal — customer, Gerard Langeler, president of Mentor Graphics Corp., Beaverton, Ore.

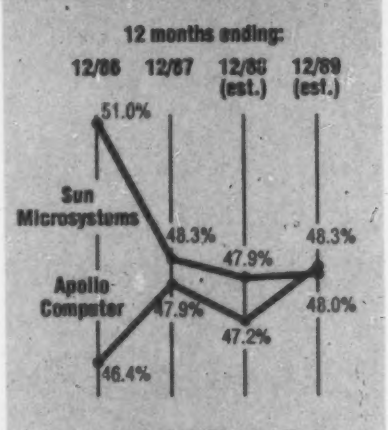
Through aggressive marketing, youthful exuberance and an emphasis on open systems, Sun last year edged out Apollo as the No. 1 supplier of technical workstations. "We're taking business away every month," claims Arun Taneja, acting director for workstation marketing at Sun, Mountain View, Calif. "And we intend to keep up the pressure." In the meantime, computer giants Digital Equipment Corp., Hewlett-Packard Co., IBM and even — recently — Apple Computer Inc., all have entered the fray.

Gerry Baskin

Apollo's Vanderslice: "We haven't been running around making rash promises"

In 1986, Apollo held the largest share of the workstation market: a 25% chunk. But in 1987, Sun took over: it shipped $645 million worth of workstations for a 26% share of the market; Apollo, with over $470 million, or 19%, came in ahead of both DEC, with $450 million; and HP, with $435 million; in workstation sales, according to Dataquest Inc. "We expect DEC to be our No. 1 competitor," says Vanderslice. Sun's Taneja agrees that Digital will be a front-line player: "We consider DEC more of a long-term threat than Apollo," he says. Digital executives were unavailable for comment.

Gross profit margins: Apollo versus Sun



Source: Prudential-Bache Securities Inc.

Even after its hefty round of price cuts on midlevel models, Apollo should top Sun in profitability by next year

For awhile it appeared that Apollo, which virtually created the workstation market in 1981, might get beaten at its own game. The company's sales continued to grow through the downturn of 1985, but its profitability did not, largely as a result of its defense of a proprietary operating-systems strategy. Sun redefined the competition when it embraced AT&T's Unix and preached the open systems philosophy.

But now the Chelmsford, Mass., firm is fighting back. While Vanderslice himself is content with a decidedly low profile, Apollo's image is looking a lot brighter these days. For the past two and a half years, Vanderslice has been quietly repositioning Apollo for growth. "We may appear conservative," concedes Vanderslice, who is growing weary of the constant comparisons with Sun. "We haven't been running around making rash promises and touting our stock. Outside we kept our heads down. But inside we've been working like mad."

Profits pay off

Lately, those efforts have been paying off. In its fiscal 1988 first quarter, ended April 2, Apollo reported record sales of $168.93 million, up 37% from the year-ago period. Earnings hit a new high as well, rising to $10.41 million, 62% above the same quarter last year. And the firm

shipped 7,400 workstations — more than any quarter in the company's seven-year history.

Coming on the heels of a strong 1987 fourth quarter, these results give analysts and company officials confidence that a turnaround is underway. "From a revenue and profitability standpoint, Apollo seems to be in a better position than Sun," says Vicki J. Brown, an analyst with International Data Corp. "Apollo is much more conservative and management has done everything to assure that it won't hit the wall again like it did in 1985. Sun hasn't stumbled yet; but it's growing so fast anything could happen."

However, Apollo recently slipped its conservative cover, borrowing a Sun tactic with price cuts of up to 35% on its Series 4000 Personal Super Workstation. Apollo is betting that the price reductions will generate a sales upturn that compensates for the lower returns.

Behind this bolder tactic lie more staid long-term strategies. While Sun's McNealy was getting much of the attention, Vanderslice was seeking a long-term remedy for what he hoped would be a short-term problem. After a devastating loss of $18.4 million in the third quarter of 1985 when computer demand dropped precipitously, Apollo derailed from its fast-growth track. The firm was committed to an expansion plan that would erode Apollo's profits until the company could rebuild its business. Vanderslice, president of GTE Corp. before he joined Apollo in 1984, moved on several fronts to guarantee that in the long term, Apollo would survive stiffening competition. Under his leadership, Apollo has:

- Diversified its customer base so that the three largest customers account for only about 15% of total business today, compared with 70% in 1985.
- Reduced geographic risk by expanding exports to more than 50% of annual sales, compared with less than 20% in 1984.
- Moved away from proprietary architecture and followed Sun's lead to open up the workplace and offer standarized products with Unix operating systems and Ethernet LANs.
- Now, Apollo has taken that strategy further by joining IBM and others to create an open software system.

Incensed that the Sun/AT&T alliance gave Sun first crack at designing products around Unix, Vanderslice led a revolt of workstation makers. "It was stupid of AT&T to take Unix proprietary," says Vanderslice with uncharacteristic venom. "I was incredulous."

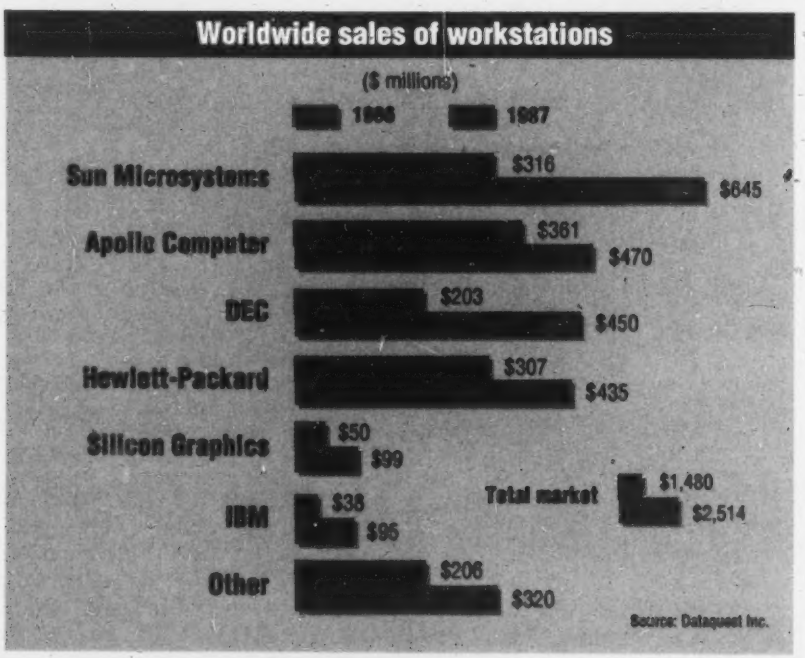
Apollo counterattacked by signing up IBM, Digital, France's Bull and Germany's Siemens and Nixdorf as charter members of the Open Software Foundation. The group will initially spend more than $90 million to develop a version of Unix that will allow all members' hardware to operate with the same software. "We are committed to open systems and this is our game plan for getting there," says Vanderslice.

This approach is far removed from Apollo's previous proprietary strategy. "Our mistake was not giving users a choice," admits J. Michael Greata, Apollo vice president for research and development and one of the firm's founders. "We should have offered both flavors [Apollo's proprietary Aegis and Unix]. We could have gone out of business if we kept trying to convince customers that one flavor was better than the other."

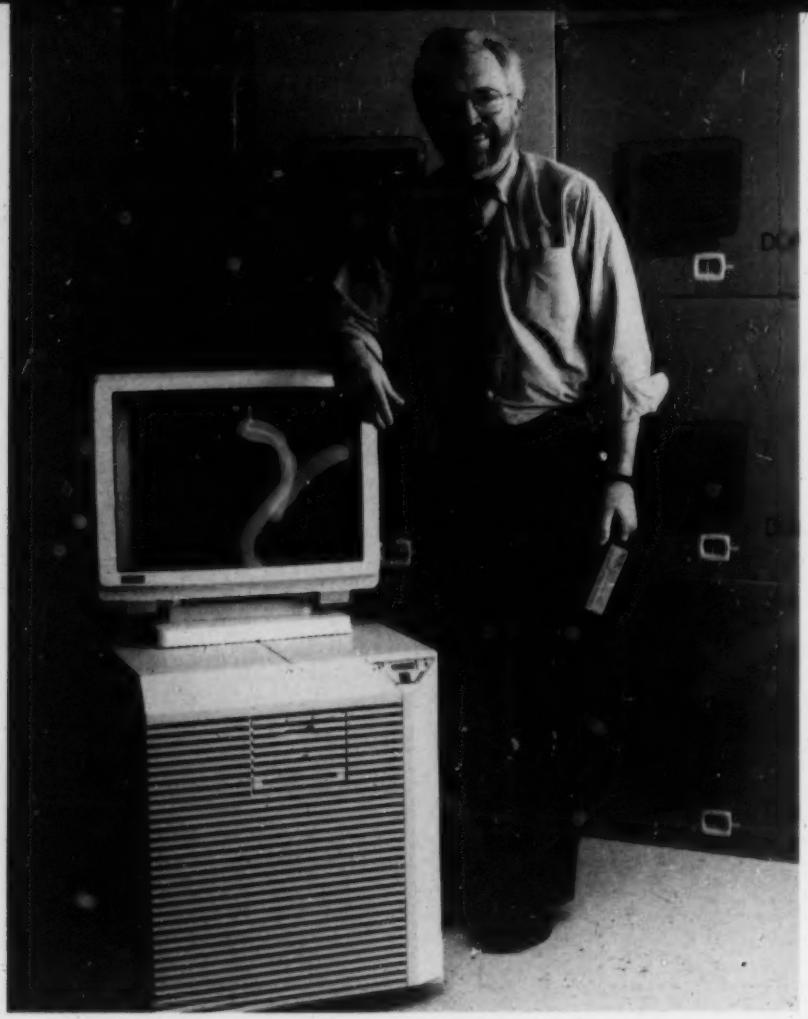
In February, Apollo introduced its Domain/OS operating system, a purer model of Unix than before. And in March, it introduced its high-end Series 10000 supercomputer, based on Apollo's own PRISM (parallel reduced instruction set multiprocessing) architecture and which boasts supercomputer-like processing speeds. "Only now is Apollo's old image beginning to give way," says Prudential-Bache's Conigliaro.

Domain/OS incorporates networking computer features into the operating system and makes it easier for third-party software developers to port applications. Scheduled for shipment in June, the new operating system offers three environments: Berkeley 4.3 Unix, AT&T's Unix System V Release 3 and Apollo's Aegis operating environment. "The world is moving to a distributed environment," says Conigliaro. "And Apollo is as much a part of this as Sun."

The Series 10000 reflects Apollo's decision to try to dominate the high-end of the workstation market and let others battle it out for the extreme low end. The line between high-end personal computers and low-end workstations is fading. "Selling boxes is not always the same as selling workstations," insists Vanderslice. "We concentrate on workstations and workgroups."



Last year, Apollo was eclipsed by Sun in sales volume



"Our mistake was not giving users a choice of operating systems," says Apollo R&D vice president J. Michael Greata. That's a mistake Apollo is fixing with Domain/OS

Gerry Baskin

It's too early to tell if Apollo will ever regain its premier position. But even if it doesn't, Vanderslice is convinced that there will be enough business for all of the leading players, although some of the less successful ventures may fall by the wayside. Industry sales increased about 150% last year alone, to $2.8 billion from $1.1 billion, according to IDC of Framingham, Mass. And sales are projected to grow at around 30% annually for the next several years, a growth rate that Vanderslice says Apollo can keep up with.

History is on his side. According to Prudential-Bache, Apollo's revenue growth has never fallen below 30% a year. That gives the investment brokerage confidence in predicting that Apollo will clear 1988 revenue of $720 million, with over $860 million for 1989.

Sistine chapel

Workstations, sophisticated desktop computers linked together in powerful networks, originally were developed for engineering applications such as circuit design and chip layout. But now, with their remarkable graphics, they are finding their way into software development, watch design, animation, financial trading, air traffic control, space station design and even preservation efforts. In Rome, for example, Apollo computers are helping painters determine the original color of Michelangelo's work on the ceiling of the Sistine chapel.

The distributed-processing concept of workstation networks is consistently winning converts away from the shared-logic approach with minicomputers or mainframes performing the tasks. Popularity of desktop workstations continues to grow as unit costs decline and computing power increases. Workstations range in price from just under $4,000 — Apollo's low-end Series 3000 Personal Workstation begins at under $5,000 — to more than $120,000.

Newcomers such as Ardent Computer Corp., Sunnyvale, Calif., and Stellar Computer Inc., Newton, Mass., are challenging Apollo at the high end, attempting to bridge the gap between high-end workstations and supercomputers. And at the low end, there's even more competition, with powerful personal computers, many with Intel Corp.'s 80386 microprocessor on board, competing with workstations. Japanese PC makers are also coming in at the low end, though it's unclear how well they will fare in the crowded field.

Sun and Apollo are meeting each other across the spectrum. "They moved up from the low end and we moved down from the high end," says Cheryl Vedoe, Apollo director for workstations, graphics and service. "At the high end, we'll continue building our 10000 well into the 1990s." Combining PRISM architecture with supercomputer technology, the Series 10000 features multiprocessors and 64-bit data paths based on supercomputer designs. Its central processing units feature high-speed integer processors and independent coequal floating point processors providing parallel instruction execution. In its single-processor version, Apollo claims it will offer from 15-to 30-MIPS processing speed for under $70,000, and up to 100 MIPS with four processors for about twice that.

Uncharacteristically, Apollo announced the Series 10000 on March 1, well before it was ready to ship in the third quarter of this year. Sun, for one, isn't convinced that the system will be delivered anytime soon. "It might as well be infinity as far as customers are concerned," snipes Sun's Taneja.

Sun is cocky. And for good reasons. "Sun is the best high-technology marketing company in the world," says Mentor's Langeler. But being the best marketing company doesn't necessarily guarantee success. "The hottest platform of the year doesn't always serve the shareholders and customers in the best way," according to Langeler who, while considering adding a second supplier, does not intend to abandon Apollo. "We would never leave Apollo," he says. "We have too many happy customers."

The conservative, controlled-growth approach could win in the end. And that's what Apollo — and Vanderslice — are betting on. "People love entrepreneurs and are deeply suspicious of professional business-

Cheryl Vedoe, Apollo's director of workstations: "Sun moved up from the low end and we moved down from the high end"

Gerry Baskin

men," says Vanderslice. "But often the professional businessmen remain long after the flashy entrepreneurs burn themselves out. Long-term success takes much longer to seed." If Vanderslice seems rankled by the disparate images of the entrepreneur and the seasoned businessman, it's because he falls into the latter, less glitzy, category. He has been a professional businessman for over 30 years: before his tenure at GTE, he spent 23 years at General Electric Co.

Ferrari Testarossa

One reporter for a major daily business newspaper believed that Vanderslice's low profile gave him the perfect story on East Coast-West Coast culture clash: seeing California-based Sun executives in their sporty import autos, he reasoned that the staid New Englanders at Apollo would drive nothing more exotic than Lincolns. He was wrong. Vanderslice drives a Jeep, while his chief technical officer, David L. Nelson, pilots a Ferrari Testarossa.

Shortly after he took over at Apollo, Vanderslice began cautioning the financial community not to expect spectacular — or even very good — earnings for the near term. "We will not deliver great profits until we grow to $150 million or $160 million a quarter," he told Wall Street. Apollo had a plant designed to produce that much product and Vanderslice realized that the company's earnings would grow only marginally until that magic figure was reached. No further expansion is needed for several years, he says, because Apollo's manufacturing facilities have a capacity of $1.2 billion worth of sales running at full capacity.

Had Apollo not implemented the hefty price cuts on its Series 4000 models, Vanderslice's plans might have given the company an edge in profitability this year, according to Wall Street observers. Prudential-Bache was predicting that Apollo's gross margins would have reached 48.9% for the year ending December 1988, leading Sun's by one percentage point. But even with the price cuts, the investment brokerage now forecasts that the gross-margins prize will be Apollo's next year: 48.3% for the year ending December 1989, against 48.0% for Sun.

But Vanderslice does not make hay with predictions. While competitors are boasting about anticipated increases in earnings and revenue, Apollo has played it close to the vest; maybe a little too close to the vest, according to some. Even Vanderslice admits he he may not be enough of a cheerleader to encourage investors. "There must be something wrong with my approach," he says, contrasting Apollo's stock price in 1982 with its lower figure today.

Upon arriving at Apollo in 1984, one of Vanderslice's first — and most critical — decisions was to determine whether or not Apollo should follow Sun's lead and develop standardized workstations for a multivendor environment. "It was difficult," recalls Vanderslice. "Some of our people had developed what they considered a much better system."

Many customers agree. "It's outstanding," says Dennis Gaugham, manager for development and engineering with the Software Productivity Consortium (SPC), a group of 14 aerospace and electronics companies that have teamed up to develop advanced software tools and techniques. "We wanted to make sure that we had that kind of sophistication," says Gaugham. The consortium also wanted to be certain that Apollo's products could be integrated in a multivendor workplace. And, says Gaugham, who professes a dispassionate and objective approach to computer purchases: "Apollo has done a great job of opening up."

SPC, which has installed 157 Apollos to date, is considered by workstation manufacturers to be one of the pioneer test sites for a multivendor approach. SPC has three Sun workstations, a Digital Equipment minicomputer and about a dozen Digital workstations, with plans to acquire more products from all the companies. "Our major customers all have one of everything," says Gaugham. Crucial to SPC's mission, then, is to develop a powerful network of workstations from different vendors.

Apollo still hasn't decided how much of its proprietary technology it will make available to customers and

competitors. While Sun is virtually inviting other manufacturers to copy its products and build clones, Apollo isn't sure that's the best way to go. "It's a mixed blessing," says Vanderslice. "In some ways you get more people to use that technology. On the other hand, if you license your technology it makes it easier for people to copy your equipment."

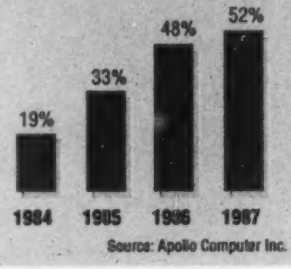
When Vanderslice came to Apollo, the company had only three customers — Mentor Graphics, Calma and Auto-trol Technology Corp. These days, Mentor accounts for only 10% of Apollo's business, compared with 25% before diversification efforts. "Our relationship has actually improved since we became less important to them," says Langeler. "They have become a much better listener and we have become more a good friend and consultant" than a complete driver of future technology.

Crippling loss

Analysts worry, however, that even at 10%, the loss of Mentor could cripple Apollo. While Langeler notes that Mentor is actively evaluating Sun and DEC products, he insists that his firm would never completely abandon Apollo. Last year, Mentor and West Germany's Siemens AG both signed $100 million contracts with Apollo. At press time, Mentor and Apollo expected to soon successfully conclude negotiations for another 12- to 18-month contract. Other customers include: Chicago Research and Trading Group Ltd., an options trading firm; Lockheed Corp. (also a big Sun customer); Seiko Watch; Waseda University, Tokyo; and Malaysia's public works department.

Overseas sales

Apollo's growing overseas sales (percentage of total sales)



Source: Apollo Computer Inc.

Strategy, Vanderslice-style: boost those overseas sales

Vanderslice points to the rapid expansion overseas, which now accounts for half of the company's total revenue. "We've probably grown a worldwide infrastructure faster than any other company in this business," boasts the usually modest Vanderslice. Selling directly into 20 countries, Apollo has operations in India, Scotland and now in China.

In Chelmsford, Apollo continues to develop future products. Some analysts expect Apollo to stress more sophisticated workstations and leave Sun and others to battle it out at the low end. But Apollo executives hint that the firm will introduce some low-end products soon. Industry watchers are betting on machines based on Motorola Inc.'s 68030 microprocessor. Meanwhile, Apollo is excited about its latest entries. "This is nothing less than a new era for computing," says Greata. "There's a visceral excitement about being at the leading edge."

How leading that edge is remains to be seen. Industry observers still maintain that if Sun's bold growth pattern continues, its revenue will be nearly twice that of Apollo's exiting 1989, as will its R&D spending. But this doesn't stop Vanderslice from waxing enthusiastically about Apollo's future. "We're getting close to a couple of hundred new customers every quarter," he says. "We're going to experience some great growth over the next three or four years." □

Apollo's foreign forays

Since Thomas A. Vanderslice took over at Apollo Computer Inc., the Chelmsford, Mass., firm has greatly increased foreign sales — from 18% of total sales in 1984 to more than 50% today. This expansion of overseas business has, in turn, led to an expansion of overseas manufacturing and service facilities. Worldwide, Apollo has 76 sales and service facilities in more than 25 countries. It is expanding its European repair and manufacturing center in Livingston, Scotland, which serves as the final assembly and test location for most of Apollo's international sales. "Ahead of Sun, Apollo put more of its resources into building up its international base," says Laura Conigliaro, an analyst with Prudential-Bache Securities. U.S. manufacturing facilities are in southeastern New Hampshire.

Since November, Apollo has announced plans for workstation assembly operations in India and a service center in China. The new Instrimpex-Apollo Computer Service Center and bonded warehouse at Qing Hua University in Beijing is the first workstation service center in China.

Last year, Apollo sold 600 workstations in China; 40% of those in Beijing. With the rapid growth of Apollo's customer base, company officials noted, Apollo has signed a contract with Instrimpex to establish a second service center and bonded warehouse in Shanghai. "We firmly believe that after-sales maintenance is a key factor to success, and this new service center will provide the best possible service to our customers in China," says Ed Goldman, Apollo's Asia-Pacific regional manager. The facility will be staffed by a team of local engineers from the Department of Computer Science at Qing Hua.

In India, meanwhile, Apollo has joined forces with HCL Ltd., India's largest computer manufacturer, to build workstations at a new facility outside New Delhi — the first of its kind in India. Officials of both firms said the HCL-Apollo manufacturing operation is an outgrowth of increased demand for Apollo workstations by engineers, engineering students and technical and business professionals in India. "Apollo will use 1988 to build upon its support infrastructure," says Conigliaro, "providing customers with full technical, marketing and support capabilities." □

How Micron is marching through the DRAM minefield

Customers are clamoring for Micron's chips as prices and profits soar. But CEO Parkinson still needs that hard hat

BY ALDEN M. HAYASHI

When Micron Technology Inc. entered the semiconductor business in 1978, people snickered. Micron's only product was DRAMs, commodity memory chips that the Japanese were already churning out by the millions. In addition, the company was not headquartered in Silicon Valley but, of all places, in Boise, Idaho. "We weren't taken seriously at first. They called us potato heads," remembers Juan Benitez, Micron president.

People are not snickering anymore. Due to the current worldwide shortage of DRAMs, customers who once snubbed Micron are now begging the company for chips. Indeed, Micron's sales should grow nearly 200%, from $91 million in fiscal 1987 (ended last September) to $267 million this year, according to a forecast by Prudential-Bache Securities Inc. Estimates from Integrated Circuit Engineering Corp. (ICE) of Scottsdale, Ariz., place the worldwide DRAM market at around $2.8 billion this year.

Although Micron is currently in the proverbial catbird seat, its position there is anything but secure. Several factors could unbalance the company:

- Intensifying competition in the DRAM market as semiconductor companies consider entering, or reentering, the marketplace.
- The next — and some say imminent — market downturn. The last downturn left Micron submerged, from March 1985 to May 1987, in a $71 million pool of red ink. At the time, some industry analysts doubted whether the company would survive.
- Less-than-harmonious relations with some key customers. Tensions are running high during these times of severe memory chip shortages. Already one customer is suing Micron for allegedly reneging on a contract.

The acute DRAM shortage and Micron's subsequent success have not gone by unnoticed by many of the major U.S. semiconductor companies, some of which retreated from the market several years ago. National Semiconductor Corp., among others, is reportedly weighing the pros and cons of reentering the marketplace, possibly by doing foundry work.

And foreign chip companies are also itching for a piece of the U.S. market, which topped $860 million last year. Europe's SGS Thomson Microelectronics Inc. is currently evaluating a plan to begin building DRAMs in its empty Phoenix, Ariz., facility. South Korea's Goldstar Technology Inc. is gearing up for a DRAM product launch in the United States later this year.

Steve Welsh

Micron is building a new fab to support the burgeoning DRAM market. Says chairman Joe Parkinson: "The momentum is very much in our favor and we expect that to continue for some time"

A fast-moving train

Nonetheless, Joseph L. Parkinson, Micron chairman and CEO, remains

undaunted. "Some people say the DRAM business is like a fast-moving train," he says. "If you get off the train, it's very tough to get back on because you've got to make up for a lot of lost ground."

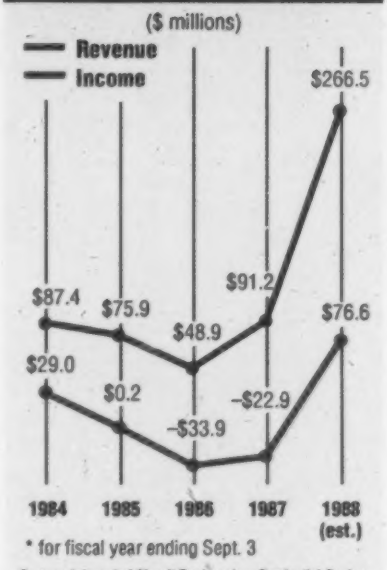
Staying abreast of the competition will not be easy for Micron. The company has to bring up a new wafer fab this year; continue lowering manufacturing costs; and make the technological transition to 1-megabit DRAM chips, capable of storing four times as much memory as 256-kilobit DRAMs.

Three months ago, Micron broke ground on a 100,000 square foot facility which will employ 1,000 new workers and double the company's manufacturing capacity, according to Parkinson. Dataquest Inc. of San Jose estimates Micron's investment at $150 million. If there are no production snags, Micron could be making chips there as early as April of next year, according to Parkinson. He is counting on the new fab, Micron's third, to help the company capitalize on the current shortage in the marketplace. "Right now, production is our limiting factor," he says. Indeed, new customers must wait months for Micron's DRAMs.

However, as other chip companies begin entering or reentering the market, and as the established DRAM vendors also begin to step up their production, supply will quickly close in on demand, threatening Micron's current status as the U.S. vendor of the hour. DRAMs, after all, are commodity chips and Japanese rivals, with proven manufacturing efficiency, could once again wreak havoc in the marketplace.

As the DRAM market recovers . . .

. . . so do Micron's finances*



* for fiscal year ending Sept. 3

Source: Integrated Circuit Engineering, Prudential-Bache Securities and company reports

An idiotic concept

Such pessimism infuriates Parkinson. "Just because it's a manufacturing game, does that mean that the United States is not going to be in it? We don't feel that just because the Japanese are in a market . . . that that's any reason to get out of it. . . . That strikes me as an absolutely idiotic, foreign, alien concept. Where I grew up, you don't concede that someone else can outwork you, outmanufacture you, or outthink you," lectures Parkinson, a workaholic product of rural Idaho.

Indeed, Parkinson asserts that Micron has made great strides in improving its manufacturing efficiency. According to Randal W. Chance, executive vice president in charge of manufacturing, production costs have decreased by more than 50% over the past year. Such impressive cost cutting allows Parkinson to brag, "We can compete against the Japanese head to head, toe to toe."

But there are indications that Micron may have to sharpen up its quality control. Two and a half years ago, Sun Microsystems Inc. filed a $6 million lawsuit against Micron alleging that the company knowingly shipped poor quality chips that caused a two-month shutdown of Sun's plant. The lawsuit is pending. "Micron's chips are still not of the greatest quality," adds a source from an independent testing laboratory.

Parkinson denies rumors that Micron is having quality problems in manufacturing 1-megabit DRAMs. He asserts that his company is already producing those chips in substantial quantities. In fact, 1Mb DRAMs presently account for more than 10% of Micron's total sales, says Parkinson. "Our production of 1Mb DRAMs is a *marketing* driven issue, not a technical one," insists manufacturing vice president Chance, in a subtle gibe at the several Japanese manufacturers that have reported difficulties in handling the transition to making 1Mb DRAMs.

No God-given right

The DRAM chip shortage has caused great tension in the marketplace. Last March, Atari Corp., a longtime Micron customer, filed a lawsuit against the company alleging that it had reneged on a contract to sell DRAMs at a specified price. According to court documents, Micron failed to ship the DRAMs at $3.75 apiece even though the company's cost of manufacture was only about $1.35. In its response, Micron denied that any such legitimate contract existed.

Although Parkinson will not comment on the litigation, he does express extreme resentment at being forced, during the last recession, to sell chips at bargain basement prices. "Customers now think that they have the God-given right to buy DRAMs for below cost," he huffs.

Even in these times of severe market shortages, Parkinson asserts that some customers have not yet adjusted to the new reality. "There's this tremendous attraction — it's almost like having sex — to the notion of being able to buy DRAMs at below marginal costs," he says.

Consequently, Parkinson questions whether Micron will be able to enter into any long-term alliances with its OEM customers. The company did, however, strike up a major deal last March with semiconductor manufacturer Intel Corp., through which Intel will resell Micron's memory chips. (Intel — like Advanced Micro Devices Inc., Motorola Inc. and National Semiconductor — stopped making DRAMs several years ago.)

Perhaps the greatest benefit of the current market shortage is that Mi-

cron has now been able to sell DRAMs to major customers that, until recently, had snubbed the company. "In the past, customers viewed Micron as a supplier of last resort," says Christopher D. Kirby, semiconductor analyst for Rothschild Inc. of New York City.

Even Parkinson admits as much. "One customer told us: 'If you're here five years from now, then come and talk to us,' " he remembers. "Just two or three years ago," he adds, "substantially all of our products were shipped to Atari, Commodore and Apple.... Today, we sell to almost everyone.... We have total coverage of the worldwide computer business." In fact, Micron now boasts over 1000 customers, says Parkinson.

Not playing fairly

How Micron is faring with its expanded customer base is unknown. In a subsequent court filing, Atari alleged that Micron reneged on its contracts with other companies as well. "Micron is not playing fairly with prices," grumbles the president of a major personal computer manufacturer in the U.S.

Other customers, however, have a different story to tell. "There are some people out there taking advantage of the marketplace but Micron has been fair," says William Calhoun, director of corporate procurement for Prime Computer Inc. of Natick, Mass. Adds Charles Smith, a senior vice president for industrial distributor Hall-Mark Electronics Corp. of Dallas, "Micron has been a very good supplier of ours."

Maintaining happy customers will be crucial for Micron, particularly given the cyclical nature of the semiconductor market. Parkinson admits that one reason Micron was badly hurt during the last recession was because the company's customer base was limited. "We're not as vulnerable anymore," he asserts. Rothschild's Kirby agrees: "Micron has been building quality customer relationships that will help carry them through the next downturn."

To help weather the next recession — which some Cassandras are predicting for 1989 — Micron has also been busy diversifying its product line. "If you've got a few other products, you've got a better chance at keeping the ovens burning," says Parkinson.

Micron recently introduced SRAM and video RAM chips and now sells memory board products as well. Critics, however, doubt whether the company will be able to diversify quickly enough before the next downturn occurs. Sales of 256K DRAMs still account for more than 80% of Micron's total sales, according to Prudential-Bache. "They're still basically a one-product company," says William J. McClean, ICE analyst.

Before the next recession arrives, Micron must be careful in managing its explosive growth. So far, the company has received rave reviews from the investment community. "Their management team has done an admirable job to date. They've shown that they're survivors," says E. Lawrence Hickey, investment analyst for First Analysis Corp. of Chicago.

Micron has been busy...

1. Expanding its facilities. To alleviate the current DRAM shortage, Micron commenced the construction of a new fab last March which should double the company's manufacturing capacity. Production could commence as early as April of next year.

2. Driving down costs. During the past year, Micron managed a greater than 50% reduction in manufacturing costs due, to a large extent, to the shrinking of chip die sizes. With the smaller dies, the company is now able to reap more chips per the same size silicon wafer.

3. Making the transition to 1-megabit DRAMs. While several Japanese competitors have had trouble hurdling the technological obstacles, Micron claims that 1Mb DRAMs already account for more than 10% of total sales.

4. Signing up new customers. A few years ago, most of Micron's products were shipped to Apple, Atari and Commodore. Today, the company boasts over 1000 customers, not one of which accounts for more than 5% of monthly shipments.

5. Diversifying away from DRAMs. Micron now offers a product line of SRAMs, video RAMs and memory board products. The company's long-term goal is to have a 50-50 split between sales of chips and those of board products. □

Little Bighorn revisited

Micron's management has not always been so sage. In a maneuver reminiscent of General Custer at Little Bighorn, the company ambushed the DRAM market four years ago by slashing prices almost in half, even though demand was still in excess of supply. The maneuver startled the Japanese and prompted them to retaliate, causing prices to begin a downward spiral that many industry gurus contend led to the market's eventual collapse. The U.S. government, goaded by Micron, finally intervened and found the Japanese guilty of dumping, or selling at prices below cost.

The resulting U.S.-Japan semiconductor trade pact, which set price floors on certain chips imported by the Japanese, allowed Micron to survive, asserts Sheridan Tatsuno, Dataquest analyst. Not true, says Parkinson, who insists that the situation, even at its worst, was never bleak. Parkinson credits Micron's survival to the unwavering loyalty of the company's board of directors, comprised of Idaho businessmen who were Micron's original investors. If the board had instead been controlled by typical venture capitalists, says president Benitez, "We would have been shut down by now."

The next time the market sours, it will be the Japanese who will suffer most, contends Parkinson. "I think the upcoming shakeout will be on the other side of the ocean because they now have a lot of disadvantages that we once had: a strong currency, high wage rates, astronomical land costs and construction costs that are out of sight."

Parkinson's assessment may be accurate but whether his company can endure the next recession is uncertain. Still, Micron has managed to survive thus far in a marketplace where many larger, more experienced U.S. companies have failed. For this feat alone, tenacious Micron has silenced its critics' snickers. "I don't think they're calling us potato heads anymore," says Benitez. □

Boeing's AWACS deal runs into trans-Atlantic flak

The Brits claim Boeing is giving their subcontractors too little too slowly. U.S. critics fear such offset defense deals help foreigners too much

A year and a half after the British government awarded a controversial $1.2 billion contract to The Boeing Co. for E-3 Airborne Warning and Control System (AWACS) planes, a debate over the efficacy of the deal has re-emerged. British critics are accusing Boeing of being lax in its commitment to share the contract with British firms, claiming that it has reneged on its "offset" agreement. The situation is particularly sensitive because the British canceled their own billion-dollar airborne early warning program in favor of Boeing.

On this side of the Atlantic, a similar — if somewhat less vicious — debate is underway concerning the offset issue in general. In both the halls of Congress and in offices of defense contractors, the discussion centers around the pros and cons of offsets as they affect the U.S. economy and the country's defense. Some critics contend offsets contribute to loss of American jobs and business, while others argue the opposite.

The issue of offsets — whereby a nation buying a defense system does so only in return for participation in production of the defense system or through other trade reciprocity — is of considerable concern not only to prime contractors in America's defense-electronics industry, but to subcontractors as well. Subcontractors are finding that they have critical roles to play in major deals such as Boeing's AWACS agreement.

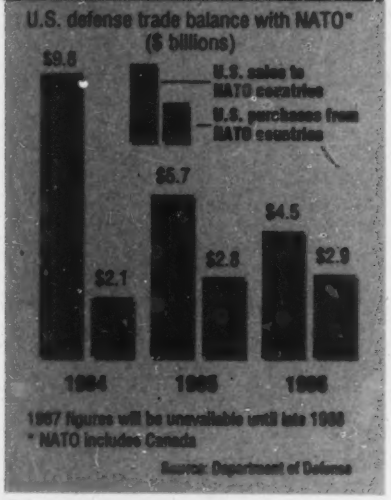
The issue is worrisome not only because the defense-electronics business is losing momentum — total procurement and RDT&E spending of $45.5 billion this year will dip to $44.5 billion in 1990, according to the Electronic Industries Association — but because imports of defense gear are growing. Studies by the Commerce Department show that the ratio of U.S. exports to imports of military merchandise fell from over 17 to 1 in 1982 to 3.5 to 1 in 1986, much of this attributable to a tripling of imports in that time.

Basically, an offset agreement allows a country buying a defense system to ensure that its own industry will benefit from the purchase either by building the system itself or by some form of indirect reciprocal trade. Offsets can involve technology transfer, coproduction or licensing agreements. Most of the countries that U.S. defense contractors deal with insist on offsets — Saudi Arabia, NATO countries, South Korea, Pakistan and Australia, to name just a few. The U.S. government, however, does not normally enter directly into offset agreements for its own foreign procurements.

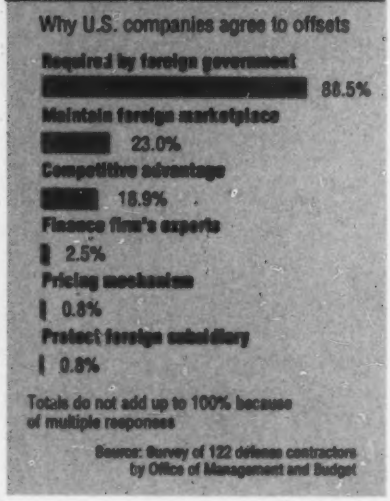
A study conducted by the Office of Management and Budget concludes that, in the past, offsets have had either no effect or a marginally positive effect on U.S. industry. The OMB estimates that between 1980 and 1984, U.S. defense-related offsets amounted to $2.4 billion, or 19.4% of the $12.4 billion in defense exports during those five years. The report says that while inefficiencies often increase as a result of offsets, revenue, profits and costs of the U.S. defense industry were not negatively affected.

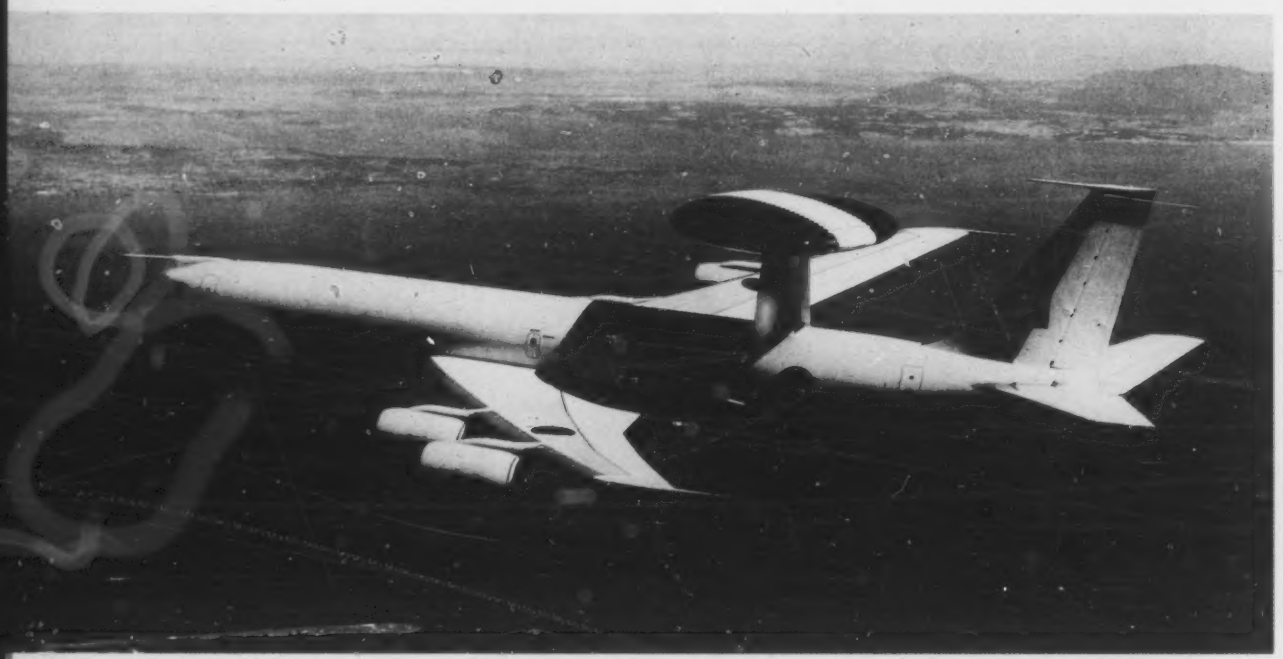
While most offsets in the past have involved modest amounts, Boeing's sale of seven E-3 AWACS planes to Britain is an exception. In its enthusiasm to win the contract, Boeing set a company precedent and raised some eyebrows in the defense industry by agreeing to a 130% offset. In other words, Boeing agreed to accept 30% more in European trade than it

America's dominance in military equipment is eroding...



...partly because U.S. companies agree to offset deals





Boeing's E-3 AWACS aircraft — early warning for AWACS operators but none for U.S. defense electronics subcontractors

would get for the AWACs it sold. Shortly after the deal was signed the French ordered four of their own AWACS from Boeing under more or less the same conditions. Concerning the British sale, a source within the British Ministry of Defence (MOD) says that some of Boeing's competition were willing to go even higher than 130%.

Shocked subcontractors

The deal shocked Boeing's U.S. subcontractors, who were not privy to the negotiations. Says one subcontractor: "Boeing's management moved quickly and decisively; [the deal] was not based on any kind of agreement with any of Boeing's subcontractors." It has also caused some concern within the Department of Defense because the agreement did not involve the U.S. government as the broker in a formal foreign military sale (FMS). Even though the top echelons of the U.S. government were backing the deal, DOD bureaucrats felt they had been left out of the action, sources say.

One of Boeing's subcontractors that lost business as a result of the offset deal was Hazeltine Corp. Siemens AG, the German electronics company, beat out Hazeltine for the data display contract, probably because of its proximity to the British and French markets. Hazeltine has had a long-standing technology-transfer relationship with Siemens in many areas including data displays, says John Colombo, director for offsets at Hazeltine. According to a Boeing spokesperson, Siemens has a "healthy load" of the offset commitment.

Boeing has been given eight years to satisfy its offset commitment and it claims it will have no trouble in doing so. The company expects about 10% will be applied directly to AWACS subcontracting to British companies, while the remaining 120% will involve indirect reciprocal purchases from Britain, mainly in high-technology products. Boeing made its first formal semiannual report to the British Ministry of Defence last October, outlining its progress in satisfying the offset requirements. A second report was sent to the MOD in April.

The first report included $141 million, of which Boeing and its subcontractor Westinghouse Electric Corp., maker of the main AN/APY-2 radar system for the AWACS, expect to get about $110 million approved. The British critics' hue and cry comes at a time when the MOD is making its judgment on that request, so it could affect whether that $110 million actually is granted.

Both sides in the deal were initially satisfied with the 130% offset. The British insisted that 130% was more than enough to create new jobs and opportunities despite the cancellation of the $1.4 billion Nimrod project, developed by General Electric Co. (Britain's GEC, no relation to the U.S. GE). Boeing was pleased with the contract because it meant that the AWACS was the dominant system in the airborne early warning market worldwide. It also means that production of AWACS in Seattle will continue, thus saving millions of dollars in shutdown and start-up costs while preserving an estimated 2,000 U.S. jobs. Nonetheless, British sources claim an estimated 2,000 jobs were lost as a result of Nimrod being canceled.

A year and a half after the signing, the Boeing-MOD honeymoon is truly over. The British press claims new business has been slow to materialize and no new jobs have been created as a result of the AWACS purchase. Although Boeing and its subcontractors agree that progress has been slow, they insist there is no intention to try to back out of the agreement.

On the contrary, Boeing takes its offset commitment very seriously, in-

sists Ralph Backes, offset and countertrade manager at the Information Systems Division at Boeing Aerospace. Along with some of its subcontractors, including IBM and Westinghouse, Boeing conducted a symposium in Britain in February 1987, with over 200 qualified defense companies, and it is evaluating projects now. Most of the 11 main U.S. subcontractors have signed "best effort" agreements with Boeing that say they will attempt to satisfy their proportion of the 130% offset.

An IBM spokesperson says Big Blue has yet to sign any contracts with British companies but it is currently involved in negotiations. IBM's Federal Systems Division is responsible for the computer, the memory drums and the operator computer control aboard the AWACS. Similarly, Eaton Corp., maker of the AWACS identify friend or foe (IFF) system, is following up with British companies for multilayer printed circuit boards and power supplies, says William Fleig, director of Identification Systems at Eaton.

Early starters

An early starter in the offset race is Hughes Aircraft Co. The maker of the AWACS' audio distribution system has assumed a $26 million offset on its $20 million AWACS contract and, according to a company spokesperson, has already placed $12 million in offset commitments with its Scottish subsidiary, Hughes Microelectronics Ltd.

One British company that stands to gain significantly from the deal is The Plessey Company Plc, a British electronics company. Prior to the signing of the AWACS agreement, Westinghouse set up its own joint venture with Plessey to explore future production possibilities. "We feel that was one of the contributing factors that helped push the [British government's] decision over the edge," says William Adams, program manager for AWACS at Westinghouse Electric Corp.'s Defense Electronics Center in Baltimore.

So far, Plessey and Westinghouse have signed a joint marketing agreement for the missile attack warning system (MAWS) that was largely developed by Plessey prior to the signing of the offset agreement, says Adams. Also, deals have been inked between Boeing and Plessey for the development of an Icelandic Air Defense System (IADS) for NATO. Neither of these agreements has progressed very far, but both will be applied to the indirect offset.

As for direct offset, the lion's share of the program is in the installation and check out (I&CO) contract and the 30-year depot contract for servicing the planes. The I&CO represents an estimated 10% of the total contract value and is expected to be awarded next month. The three contenders vying for the contract are Plessey, teamed with Ferranti Plc, Short Brothers and Racal Electronics Plc; British Aerospace; and GEC, teamed with Marconi. Westinghouse has already asked for a quote from Plessey for sending engineers to the United States for participation in the building and testing of the AWACS radar during its production cycle here, says Adams. This implies Plessey has an inside track on the I&CO contract.

IBM is negotiating offset deals for the AWACS computer and computer controls

Disappointment

While prospects for business are promising, very little has been done to date. "There is a degree of disappointment in Plessey and Britain in that [the benefits of the offset] have not been as fast as hoped," comments David Elliott, vice president of Plessey's Electronic Systems Inc., a marketing arm for Plessey in Washington, D.C. Still, Elliott is positive that programs will materialize and Boeing will come through with its 130% commitment: "We see it as a long-term relationship and want to increase the impetus with both Boeing and Westinghouse."

There are several reasons why both direct and indirect offset agreements have been slow in coming. At the top of the list is exchange rates. The value of the British pound has risen from $1.40, when the deal was signed in early 1987, to around $1.80 in April 1988, making British goods less competitive. Barkes at Boeing concedes that this change could have a negative impact on the offset because Boeing's initial offer for the planes was so competitive.

Another element causing some headaches is the speed at which the U.S. Office of Munitions grants technology transfers and license agreements for export. Boeing is committed to deliver the first AWACS in 1989 and needs to be able to share the military specifications for systems with prospective British companies. The vetting process takes 60 to 90 days which, according to both U.S. and British companies, is putting British companies at risk of missing out on the bidding process.

Adams at Westinghouse admits that Westinghouse has already had to grant subcontracts to U.S. firms over British firms because of the licensing bottleneck. The value of those contracts ranges between "tens of thousands of dollars to millions," he says.

"If I were the U.S. defense industry, faced with budget cuts like it is being faced with, the best thing that could happen would be to get the government to agree to be a bit more flexible and responsive in its licensing so it can push things through quickly," comments Roger Harding, the British Minister for Defense Materiel in Washington, D.C. Harding calls the U.S. licensing system a "painful bureaucratic process."

Looking further out, most industry experts agree that offsets will be around for a long time to come. According to the OMB study, 90% of those surveyed say offsets are just a part of doing business. But with Boeing's precedent-setting 130%, some critics claim the stage is set for other countries to demand the same rate, thus leading to the erosion of the U.S. aerospace and defense industries. Most pundits insist, however, that the circumstances of the British AWACS deal were unique and it is doubtful it will be repeated.

But it does raise the issue of how important defense-related exports are becoming to U.S. companies and highlights the lengths to which they will go to get a sale. Also, as offsets begin to have their desired effect — creating viable foreign industrial bases — the competition that U.S. firms face, both for U.S. and foreign sales, will begin to increase. And that will put the pressure on U.S. firms to make more concessions. □

Which electronics mega-deals worked — and which didn't

Full of pomp and promise, the biggest M&As in electronics haven't always worked out. Here's how readers rate eight of the largest deals of the '80s

BY NORM ALSTER

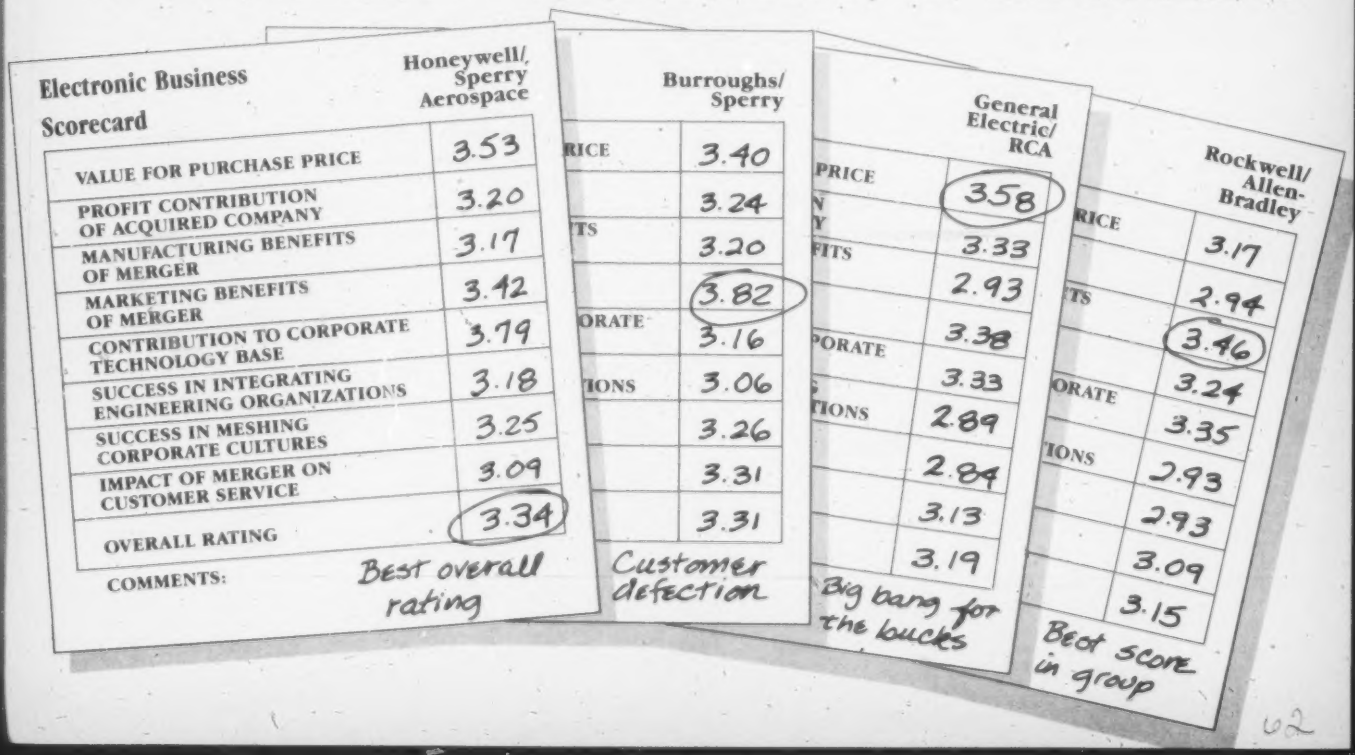
Mergers and acquisitions always generate bold headlines and reams of instant analysis. This match offers "synergy." That one insures "economies of scale" or "participation in high-growth markets." And who would dare argue with "counter-cyclical diversification?" With time, however, wholly different stories unfold: personality clashes, disappointing markets, unexpected competition, unmanageable debt, organizational mismatch, product mishmash.

Some mergers do, however, stand the test of time. To find out which of this decade's billion-dollar deals look best today, ELECTRONIC BUSINESS polled a group of 2,000 of its readers: senior executives in electronics companies plus a sampling of financial analysts. They were asked to evaluate eight of the largest acquisitions in the electronics industries during the 1980s. Among the eight criteria for evaluation were: value for purchase price; contribution to the corporate technology base; success in meshing corporate cultures; and success in integrating engineering organizations. We received exactly 100 responses.

In what was almost a dead heat, two deals were ranked well above the rest. First, by a nose, was Honeywell Inc.'s acquisition of the Sperry Aerospace Group, a deal which allowed Honeywell to strengthen its aviation business just prior to slipping out of the computer business.

Judged just a hair less favorably was a deal that actually set up the first: the $4.4 billion coupling of Burroughs Corp. and Sperry Corp. The Power of Two — now the No. 2 computer company — finished at No. 2. Actually, the success of the Burroughs/Sperry deal derives in part from the sale of its aerospace division to Honeywell. The $1 billion raised by that sale helped reduce the heavy debt burden of young Unisys Corp.

The most hapless marriage, according to survey results, featured a wealthy groom and a somewhat headstrong young bride. Physical attraction was indisputable. Indeed, some felt there was electricity in the air when IBM purchased Silicon Valley superstar Rolm Corp. But communications soon broke down. "It was like trying to fit a Rolm peg into a square hole," reckons David Kunstler, vice



president of Toqueville Asset Management Corp., an institutional money management firm.

Another deal fouled by crossed wires involved an even wealthier suitor. General Motors Corp.'s harrowing absorption of Electronic Data Systems drew the lowest scores in the survey for "success in integrating engineering organizations, success in meshing corporate cultures," and "impact of merger on customer service."

The beauty of the Sperry acquisition for Honeywell was that it greased the skids for Honeywell's exit from the computer business. "As they continued to deemphasize computers, they really needed to replace the revenues," says Howard P. Sadtler, director of investment strategy at Branch Cabell & Co. and a respondent to the survey. The acquisition of gyroscope pioneer Sperry Aerospace "strengthened an already strong Honeywell position in aerospace and defense," according to Sadtler. Honeywell was therefore able to build a new core business — now accounting for roughly half of corporate sales — as it prepared to cut the cord on its backbone business in computers.

The Burroughs/Sperry liaison is described as "a marriage made in heaven" by Sadtler. Sperry and Burroughs were each faced with shrinking computer franchises and the prospect of accelerating defections from their mainframe customer bases. The merger, reasons Sadtler, reassured customers that the new combine was in the computer business to stay.

There was, however, an unsavory aspect to the deal. Many heads rolled so that Unisys might live. Sadtler estimates that 15,000 or more Burroughs and Sperry employees were terminated. Surprising, then, that one survey respondent actually gives Unisys good grades for "managing human resources." Timothy Propeck, a vice president with Advanced Micro Devices Inc., says top management exhibited "fairmindedness" in making personnel decisions. "They laid off a lot of people. But they were real up-front," says Propek. "And they didn't favor one side over the other."

Despite its poor rating as a merger, the IBM-Rolm purchase succeeded on one count: it maintained IBM's unblemished record of failure in trying to buy its way into telecommunications. With its Satellite Business Systems spinning zeroes at a dizzying pace and with private branch exchange switch maker Mitel unable to deliver the new switch it was developing for the Armonk, New York-based computer giant, IBM turned to Rolm, one of the more glamorous addresses in Silicon Valley during the early '80s.

But the neighborhood deteriorated quickly after IBM moved in. The PBX business fizzled, as did the quixotic notion of convergent computer and communications technologies. One respondent, declining identification, says IBM "grossly overpaid" for Rolm when its business was skidding downhill. IBM may have also overpaid Rolm executives in sweetening the deal, he adds. Some key Rolm executives were so enriched they found little reason to stay after the merger. □

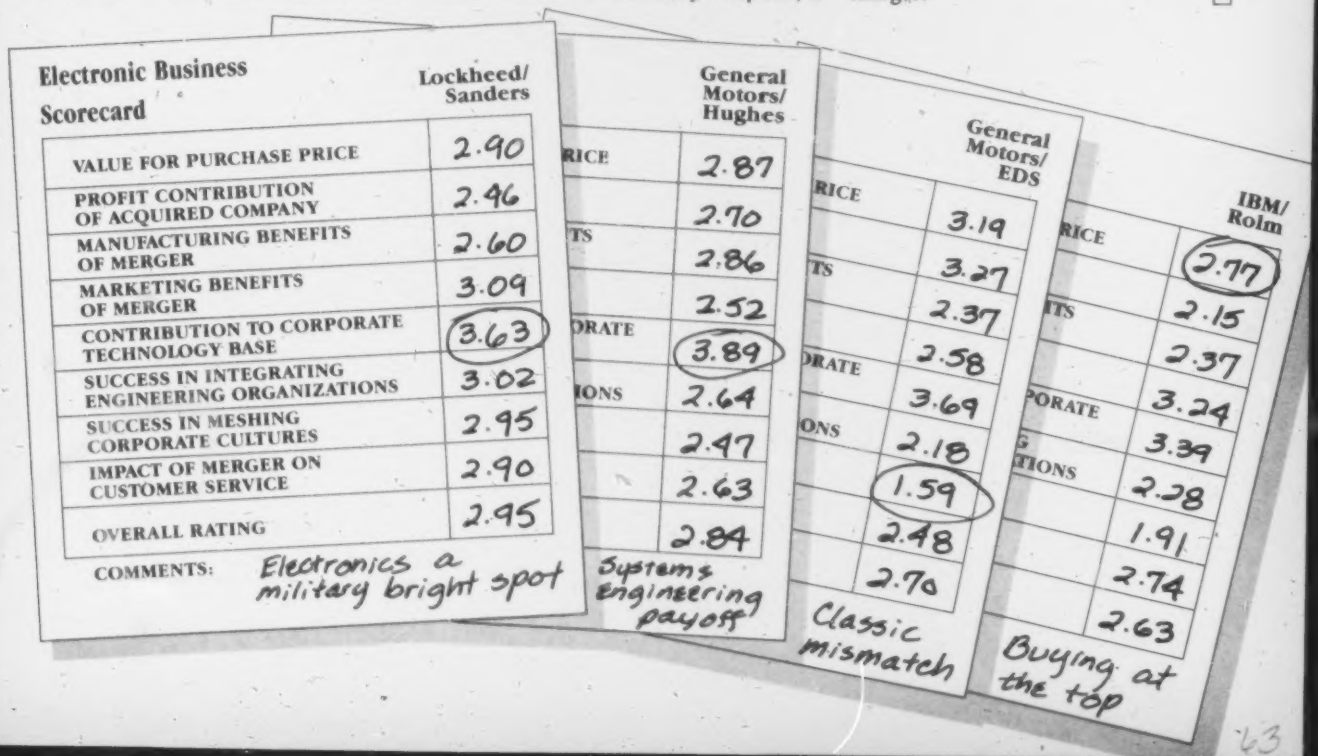
Ranking the mega-deals

A ranking of electronics industry mega-deals — from most to least successful — by the readers of ELECTRONIC BUSINESS

Value of deals ($ billions)

1. **Honeywell/Sperry Aerospace** ($1.0)
2. **Burroughs/Sperry** ($4.4)
3. **General Electric/RCA** ($6.2)
4. **Rockwell/Allen-Bradley** ($1.7)
5. **Lockheed/Sanders** ($1.2)
6. **General Motors/ Hughes** ($5.2)
7. **General Motors/EDS** ($2.5)
8. **IBM/Rolm** ($1.3)

Source: ELECTRONIC BUSINESS



Electronic Business Scorecard

	Lockheed/ Sanders	General Motors/ Hughes	General Motors/ EDS	IBM/ Rolm
VALUE FOR PURCHASE PRICE	2.90	2.87	3.19	2.77
PROFIT CONTRIBUTION OF ACQUIRED COMPANY	2.46	2.70	3.27	2.15
MANUFACTURING BENEFITS OF MERGER	2.60	2.86	2.37	2.37
MARKETING BENEFITS OF MERGER	3.09	2.52	2.58	3.24
CONTRIBUTION TO CORPORATE TECHNOLOGY BASE	3.63	3.89	3.69	3.39
SUCCESS IN INTEGRATING ENGINEERING ORGANIZATIONS	3.02	2.64	2.18	2.28
SUCCESS IN MESHING CORPORATE CULTURES	2.95	2.47	1.59	1.91
IMPACT OF MERGER ON CUSTOMER SERVICE	2.90	2.63	2.48	2.74
OVERALL RATING	2.95	2.84	2.70	2.63

COMMENTS: Electronics a military bright spot | Systems engineering payoff | Classic mismatch | Buying at the top

M&A mega-deals dominate, but mini-deals proliferate

In their search for "critical mass" and better distribution channels, smaller companies are following the mergers-and-acquisitions route too

BY ANNE KNOWLES

Mega-deals are what merger mania is all about, right? Mammoth mergers like that of Burroughs Corp. and Sperry Corp. are fueling the current mergers-and-acquisitions — or M&A — craze. Or so it seems.

It is true that so-called mega-deals like Unisys Corp. represent more M&A dollars and have the greatest impact on the industries they compete in. It is also true that M&A specialists on Wall Street fan the flames of larger deals because of the correspondingly larger fees they generate, says Harry K. Rosenthal, vice president and senior telecommunications equipment analyst at Prudential-Bache Capital Funding in New York City.

In reality, however, the majority of M&A activity is on a much smaller scale. Last year, in the information technology industry, there were 574 transactions worth nearly $10 billion altogether, according to Broadview Associates, a Fort Lee, N.J., firm that puts together and analyzes M&A deals. Only 11 of those deals, though, were valued above $200 million.

Much more common is the "mini-deal" — acquisitions ranging from Tandon Corp.'s $2.75 million purchase of Atasi Corp. to National Semiconductor Corp.'s $122 million acquisition of Schlumberger Ltd.'s Fairchild Semiconductor Corp. divestiture.

The momentum in all M&A activity is being driven by a number of factors. In addition to encouragement from the financial community, says Prudential-Bache's Rosenthal, a trend toward globalization is pushing companies, large and small, to expand their businesses through mergers and acquisitions.

A case in point is Dynatech Corp., a diversified communications supplier in Burlington, Mass. Dynatech, which had $304 million in sales last year, is a medium-sized company that has been an active buyer of other companies. The 19-year-old corporation has completed over 60 acquisitions since 1979, according to John Powers, vice president for corporate development. Powers says the company has six full-time employees, in addition to himself, in charge of researching, negotiating and completing the acquisitions.

"Diversification is a major theme" at Dynatech, says Powers. "Our strategy is to compete in small niche markets. We are not particular about which markets [the acquired companies] are in as long as they are technologically innovative and have good management."

Powers believes Dynatech has a healthy track record. Of those 60 acquisitions, Dynatech has "probably sold two companies, closed two or three small operations, merged a few and still has some that aren't doing that well," says Powers. Most of the deals, says Powers, have been negotiated through stock, rather than paid for in cash, due to accounting practices associated with cash deals that result in higher taxes. Charlie Federman, a partner with Broadview Associates, says most smaller acquisitions and mergers are completed with stock for that very reason.

While all deals are unique, says Powers, successful deals do have common attributes. One is that the acquired company must have a well-defined niche, says Powers. Another factor is a good management team already in place. Dynatech prefers to buy a company whose management has reached its financial goals and is instead motivated by achievement, says Powers. "We don't do turnarounds," says Powers. "Each division is autonomous and we depend on management to stay." For that reason, says Powers, Dynatech buys only privately held companies.

In contrast to larger deals, smaller acquisitions are almost always

M&A activity in electronics

Mergers and acquisitions in the information technology industry

	1986	1987	Percentage change
Information services and software	305	358	17%
Computer and communications hardware	127	141	11%
Telecommunications carriers	39	46	18%
Other	23	29	26%
Total transactions	494	574	16%
Total price paid* ($ billions)	$20	$10	NM**

Source: Broadview Associates

* Total price paid is an estimate. The dollar values of many transactions under $15 million are not reported

** Not meaningful—In 1986, numerous megadeals, such as Burroughs Corp.'s $4.4 billion acquisition of Sperry Corp., resulted in a large total price paid

A trend toward globalization is pushing electronics companies, large and small, to expand their businesses through mergers and acquisitions

Greg Couch

friendly, says Broadview's Federman. The companies are usually privately held. Either the acquired company's management or the venture capitalists who have backed the company are interested in being bought. The buyer, also likely to be a privately held company, may want to go public and grows through acquisition in order to attract public investors.

A driving factor specific to small acquisitions is that need to obtain "critical mass," says Prudential-Bache's Rosenthal. That gives companies the incentive to both acquire and be acquired. "There is a growing awareness among entrepreneurs that at some point they will have to sell out," Rosenthal contends. An unusual case in point is Timeplex Inc. Last year, Timeplex acquired Cygnus Computer Corp., a maker of fast packet switches, only, in turn, to be bought by Unisys Corp. "That's a case of a minnow being swallowed by a shark being swallowed by a whale," says Broadview's Federman.

The most common reason small-to medium-sized companies acquire other companies is to expand their distribution channels — an aspect of business that becomes increasingly important as the electronics, computer and communications industry move toward standards. "Innovation," says Broadview's Federman, "is not as important as distribution."

Wavetek Corp., a test and measurement firm in San Diego, bought Datron Instruments Inc., a maker of multimeters and calibrators, for $15.8 million in cash. Datron, which had moved its headquarters to the United States but was actually owned by Britain's Datron International Plc, had let expenses run too high while business was slowing down, according to Wavetek vice president for human resources Dan Sullivan. Datron, says Sullivan, needed to either restructure or put itself on the auction block. And Wavetek, with $22 million in the bank, was looking. The two companies had similiar product lines, but Wavetek wanted to expand its distribution channels in Europe.

A small company may also want or need another company's product line, either to broaden their own set of products or to put them in the technological lead in their industry. The easiest, quickest, and sometimes least-expensive way to do that is to acquire the entire company.

Adage Inc., a computer graphics terminal maker in Billerica, Mass., wanted to broaden its product line in order to enter the IBM-compatible CAD/CAM market. CGX had spent $4 million developing such a product, says Jim Norrod, president of Adage and former president of CGX. Last fall, $40 million Adage acquired CGX Corp., which had about $8 million in sales, for $16 million.

The Adage-CGX merger turned into a classic turnaround, says Norrod. And in many ways, the acquired company ended up turning around its parent. Adage had been in the red since 1985, says Norrod, while CGX was profitable. After the acquisition, Norrod remained president of CGX, as a separate division, and became a vice president of Adage. Within two months, however, Norrod put together a new business plan for the merged company and presented it to the board of directors. Norrod wanted to move more manufacturing outside of the company, consolidate the product line by reducing it from 23 products to eight, and realign the sales organization by putting more emphasis in international markets, which accounted for one-third of the company's revenue. The board accepted his proposal, elected the then-current president to chairman of the board and promoted Norrod to president of Adage.

Now CGX, according to Norrod, has the largest market share, after IBM, in the 5080 terminal emulation market. He expects the company will continue to lose money for the next few years but says Adage is on track in its business plan. And despite the fact the merged company, "has taken on a new identity," according to Norrod, CGX's influence is apparent. Adage is now run like a small company, says Norrod. It is headed by Norrod and three vice presidents, two of whom came from CGX. Before the merger, Adage had nine vice presidents. The workforce has been reduced to 320 employees, from a total of 500 from both companies, to cut costs. Manufacturing employment has been cut, but 70 of the 80 former CGX employees remain. □

Compare your company to the Japanese

Fujitsu spends 8.6% of its total sales on manufacturing labor. Hitachi spends 13.8%. What does your company spend?

BY PAULA DOE

Want to know how your firm stacks up against the fabled productivity of the Japanese? From company reports *(Yuka Shoken Hokokusho Soran)* filed with the Japanese government and recently released by the country's Ministry of Finance, figures are now available to help you make the comparison [see accompanying table]. These financial numbers, never before published in English, reveal the detailed cost structure of the Japanese electronics manufacturer, listing everything from manufacturing overhead to advertising expenses.

Four companies — Fujitsu Ltd., Hitachi Ltd., Matsushita Electric Industrial Company Ltd. and NEC Corp. — were selected as a small sampling of Japan's major electronics corporations. Except for Matsushita, the figures for the companies are for the fiscal year ending March 1987. (Similar figures for the most recent fiscal year ending last March will not be available until late this year or early next year.) Because Matsushita recently changed its fiscal year, the most current figures available for the company were for the year which ended in November 1986.

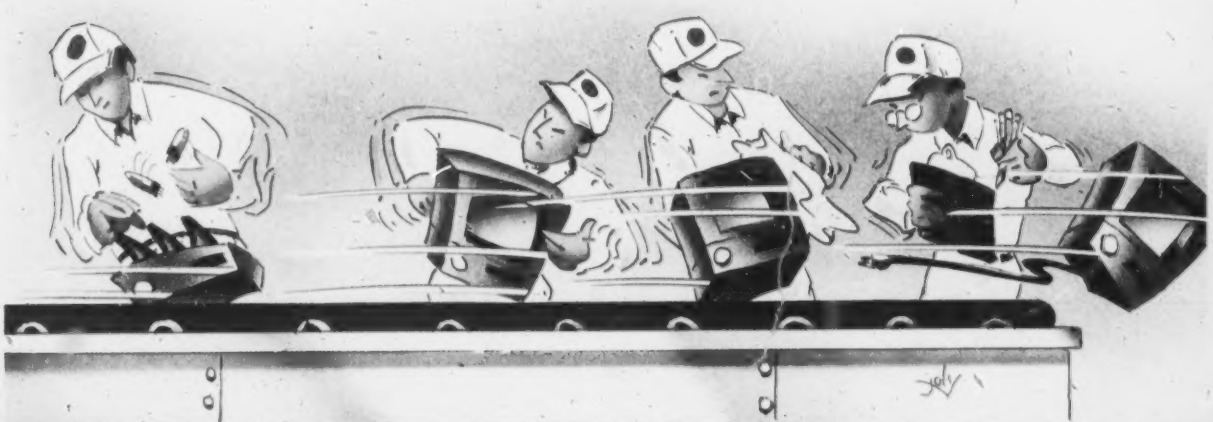
Sales per employee at the major Japanese companies remained astronomically high and the rising value of the yen puffed them up even more. Matsushita reported an astounding $541,600 revenue per employee. But these figures are for the Japanese parent company only and are not directly comparable to a U.S. company's consolidated results. The Japanese parent company keeps its own number of employees down by relying heavily on workers at subsidiaries and affiliated subcontractors.

The major Japanese producers run with lean management

Consolidating the parent's results with its subsidiaries brings the average sales per employee at the top 20 largest Japanese electronics companies down to $164,400 for 1986 [ELECTRONIC BUSINESS, Oct. 1, 1987, p.75]. Still, the comparable figure for the United States' top 20 was $94,000. Work done by other, unconsolidated Japanese affiliates probably accounts for some of the remaining difference. However, some other key differences are also notable.

The Japanese invest massive amounts of capital per worker. At NEC's Tamagawa plant, which makes integrated circuits and telecommunications transmission gear, there was $30,200 worth of capital equipment for each of the 9,068 employees for fiscal 1986 (ended in March 1987). At Hitachi's Musashi integrated circuit plant, investment other than land and buildings was $29,000 for each of the 3,756 employees. At Fujitsu's Numazu computer plant, equipment investment was $23,200 for each of the 2,547 employees.

Matsushita gets by for surprisingly less, doubtless in part because its product mix tends toward simpler



Productivity of major Japanese electronics manufacturers

	Matsushita	NEC	Hitachi	Fujitsu
1987 sales ($ billions)* **	**$21.7**	**$14.5**	**$20.0**	**$10.2**
Relative costs				
(as percent of total sales)				
Cost of sales	**82.1%**	**70.3%**	**78.6%**	**70.3%**
Cost of goods purchased	56.0%	15.0%	0.0%*	14.4%
Cost of manufacturing	23.6%	56.5%	77.7%	58.5%
Materials	17.7%	47.6%	43.1%	45.6%
Labor	3.9%	8.1%	13.8%	8.6%
Overhead	2.0%	13.9%	16.4%	2.5%
Depreciation	0.9%	3.1%	4.5%	4.2%
Materials inventory	-0.1%	0.3%	-0.1%	-1.2%
Account transfers	-0.8%	-16.3%	0.0%	-1.2%
Inventory write-down	0.0%*	-0.2%	0.0%*	0.0%*
Product inventory	0.2%	-0.9%	0.9%	0.2%
Account transfers	0.4%	0.0%*	0.0%*	-2.8%
Inventory write-downs	0.0%*	-0.3%	0.0%*	0.0%*
Sales tax	1.9%	0.0%*	0.0%*	0.0%*
Selling, general & administrative costs	**15.5%**	**26.6%**	**18.5%**	**27.7%**
Direct selling expenses	5.4%	0.0%*	0.0%*	0.0%*
Personnel	4.0%	3.0%	2.1%	7.1%
Sales promotion	1.1%	4.3%	0.0%*	0.8%
Sales commissions	0.0%*	0.0%*	0.0%*	2.2%
Advertising	0.8%	1.2%	0.8%	0.8%
Shipping	0.8%	2.2%	2.1%	1.4%
Depreciation	0.6%	0.5%	0.1%	1.9%
Rents & leases	0.5%	0.0%*	0.0%*	0.4%
Supplies	0.5%	0.0%*	0.0%*	0.0%*
Travel	0.4%	0.0%*	0.0%*	0.0%*
Communication	0.1%	0.0%*	0.0%*	0.0%*
R&D	0.0%*	8.3%	5.6%	8.1%
Other	1.3%	7.1%	7.8%	5.0%
Operating income	**2.4%**	**3.1%**	**2.9%**	**2.0%**

	Matsushita	NEC	Hitachi	Fujitsu
Productivity				
(dollar figures in thousands)				
Sales/employee	$541.6	$379.1	$256.9	$201.5
Operating income/employee	$12.7	$11.9	$7.4	$4.0
Value added/employee	$107.7	$34.7	$81.5	$58.0
Value added/dollar personnel expense	2.52	0.83	1.98	1.83
Value added/dollar investment	0.45	0.18	0.66	0.44
Other selected operating ratios				
(dollar figures in thousands)				
Manufacturing labor/ operating costs	10%	8%	14%	10%
Total personnel costs/ operating costs	20%	11%	17%	18%
Direct labor/indirect labor	2.1	3.2	3.9	2.7
Sales to related companies/ total sales**	72%	32%	44%	25%
Purchases from related companies/ total purchases**	71%	89%	99%	NA
Assets/employee	$21.3	$53.1	$37.2	$50.2
Equipment/employee	$9.6	$36.5	$27.4	$31.5
Personnel expense/employee	$42.8	$41.6	$41.1	$31.7

*may be accounted for under a different heading

**related companies include subsidiaries and affiliates

***Figures are for the parent companies only, for the fiscal year ending March 1987. (Figures for the most recent fiscal year ending last March will not be available until late this year or early next year.) The numbers do not include the financial results of each company's subsidiaries. Because Matsushita recently changed its fiscal year, its figures are for the most recent full year available, which ended in November 1986.

An exchange rate of $1 = ¥146 was used.

Source: Company reports *(Yuka Shoken Hokokusho Soran)* published by Japan's Ministry of Finance

consumer electronics products. Even at its massive Kadoma plant in Osaka, which makes office and factory automation equipment as well as video cassette recorders and audio equipment, investment other than land and buildings was only $8,700 for each of the 7,044 employees.

Running lean

The major Japanese electronics producers also run with remarkably lean management. Ratios of direct to indirect labor usually fall somewhere between 2.0 and 4.0, roughly meaning that there are 2 to 4 manufacturing blue collar workers for every white collar manager. For U.S. companies, the ratio is usually reversed; in other words, American managers outnumber the workers they are managing, according to Pittiglio, Rabin, Todd & McGrath, a Boston consulting firm.

However, the Japanese figures exaggerate the number of production workers slightly, since they include plant management as direct labor. Still, it is notable that Matsushita ran its $22 billion business with only 1,452 total employees at its corporate headquarters in 1986 — while 1,917 people worked in its research laboratories. The company employed another 7,500 in sales and administration in branch offices and 27,000 in its plants.

Despite lean management at the major Japanese electronics companies, personnel costs are still a major expense. Although some pundits argue that labor costs have become an insignificant part of manufacturing, total personnel expenses reached up to 20% of Matsushita's total operating costs. It's no wonder why Japanese manufacturers are still rushing production offshore. □

VGA boards offer a colorful future for board makers

The new graphics standard on IBM's PS/2 line has created some problems, but more opportunities, for graphic board makers

When IBM announced its Personal System/2 computer line, it created a variety of opportunities for the computer industry. One of the major opportunities was that of upgrading the performance or features of the so-called "classic bus" computers — those using the PC or AT bus — to match the capabilities of the PS/2 line.

The one area where demand from classic bus users quickly became clear, and which was thought by board makers to be relatively simple to copy, was the video graphics array specification. VGA provides higher resolution than the VGA and CGA graphic display standards of the PC XT and PC AT computers, while providing more colors — up to 256 —to be displayed on-screen simultaneously. Indeed, early versions of EGA boards were shipped less than six months after the VGA spec was described.

"VGA is pretty darned good," says Eric Shealy, product manager for graphics at Everex, in Fremont, Calif. Although the sales of EGA controller cards are still stronger than VGA cards, VGA is catching up fast, according to industry sources.

One of the reasons VGA will compete well, and quickly, with EGA as the predominant display standard for PCs comes clearly into focus when the idea of a display system comes into play.

EGA adapters produce a purely digital video signal. The adapters emulate other, lower resolution video modes by producing a slower video signal. As video resolution increases, scan frequencies and video signal frequencies also increase, allowing the higher resolution signal to be transmitted for reproduction by the monitor.

The increase in resolution has required creative solutions. One prominent solution is the so-called multiscan or multifrequency monitor. This method has been described by one industry watcher as a "brute force" approach to compatibility with the variety of graphics modes currently available. Although the multiscan monitors work, there are a number of drawbacks.

At the same time, VGA is designed to produce a purely analog signal. The analog signal is a single, fixed frequency, roughly 31.5 KHz. Compatibility with other video modes is adjusted by the board's dot clock. With lower resolution modes, such as EGA, CGA or MDA (monochrome display array), the electronics on the VGA boards reduces the number of dots sent to the monitor, while maintaining the same signal frequency.

Building a VGA analog monitor is a fairly simple task, when compared with building a multiscan monitor. Since the monitor will operate at only one scan rate, there is no need for special circuitry to adjust to other rates. And since the display uses a single frequency, the display can be optimized for maximum clarity and color definition. This adds up to a monitor that is both superior to multiscan monitors, and also less expensive to build. "Analog monitors are cheaper to manufacture," says Andy Fischer, director of operations at Hercules Computer Technology, in Berkeley, Calif. "And there are some nice clone monitors coming out," adds Fischer.

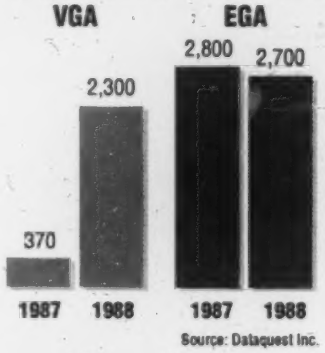
The combination of EGA card and multiscan monitor is currently running at near parity to the VGA card/VGA monitor combination. However, VGA monitor/card combinations will soon become much less expensive, and more desirable than EGA due to economies of scale that will bring down the costs of the cards and monitors.

In spite of the obvious bright future for VGA, and its apparent dominance for the next two or more years, a number of issues have arisen around VGA boards. Board makers quickly decided that, in order to compete with the IBM VGA board, which only provided VGA display modes, full downward compatibility was required. VGA emulation is a fairly simple trick when emulating just the VGA modes, and producing a single frequency, analog signal. However, the computer world is mostly equipped with TTL monitors, which the IBM card does not support, and which most potential card buyers would like to not have to replace —at least until such time as a tangible benefit is demonstrable. And the computer world is using software that runs in lower resolution modes.

Thus, board makers quickly real-

PC/AT graphics boards

Worldwide units shipments (thousands)



Source: Dataquest Inc.

Shipments of VGA graphics boards jump while shipments of older EGA boards stall

ized that, to be successful, a VGA board for PC AT bus architecture must also produce a TTL digital signal. It also must support EGA, CGA, and MDA display modes, and not require the card buyer to replace his or her monitor to use the board. At least, not until software requiring a better monitor becomes available.

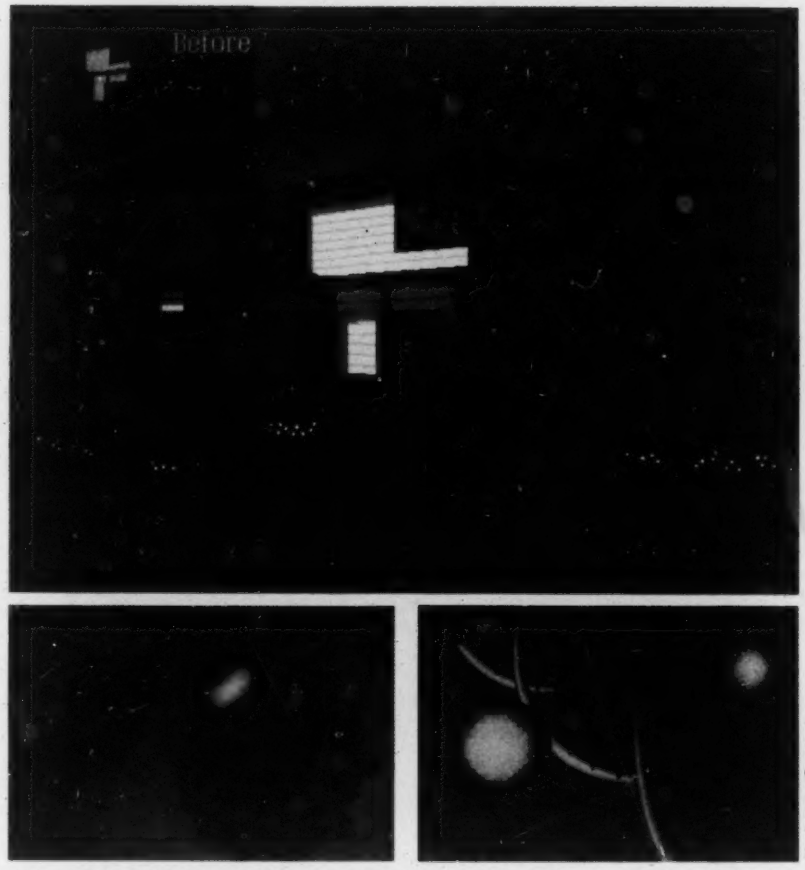
Compatibility with all modes became a stumbling block that a few companies actually tripped over. Initial VGA board shipments boasted BIOS level compatibility with all modes. However, problems were encountered with software that bypasses BIOS and writes directly to registers. Such software rather rapidly showed up incompatibilities inherent in these "100% compatible" VGA adapter cards.

A second generation of VGA boards has been developed, promising register-level compatibility. "It is important to be as register level compatible as you can be. If you're not, it can lead into problems," says Everex's Shealy. "The question of compatibility only becomes an issue if software doesn't run [on the board]," opines Hercules' Fischer. "BIOS level is fine in an ideal world," continues Fischer, "but this isn't an ideal world. I'd like to raise the level of debate regarding register level compatibility and BIOS level compatibility and what is best."

IBM has included some undocumented registers to its own VGA circuitry. Reverse engineering the VGA has revealed those registers to the board makers. There is some speculation that IBM's version of OS/2, the operating system developed for PS/2, will make functional calls to those undocumented registers as a test for a "true IBM" VGA board, thus rendering clone boards incompatible.

"IBM has the ability to throw a monkey wrench in by doing something that nobody else does," says Shealy. "It is a potential threat that can be overcome, but will cause us to do some scrambling."

Craig Lynar, vice president for marketing at Orchid Technology, in Fremont, Calif., doesn't see the undocumented registers as posing a potential trap. "IBM would be foolish to use them (the registers) if they are not documented. They need to get PS/2 off the ground. The corporate world is still leery about PS/2, and if IBM changes its video after one year, the corporate world will be behind again. IBM will most likely follow the standard specs that they've already published," believes Lynar.



The Imagery Group

VGA provides higher resolution than standard graphics modes available on PCs and is capable of displaying up to 256 colors

Another issue relates to the Video Adapter Connector, a jack that is built into PS/2 computers and is expected to allow special graphics modes to be produced. Hercules, for example, is developing an adapter board that would connect to the video adapter jack and allow the use of RAMFONTS, character fonts that are produced by RAM on the board, and are said to be much faster to create than those using standard video boards. IBM's 8514A board works in conjunction with the connector to produce higher resolution VGA graphics.

But, in spite of development efforts that make use of the adapter jack, the jack "will be a curiosity," admits Fischer. "The industry has always mimicked what IBM has done for fear that if it didn't, it would run into problems," says Shealy.

"The feature connector on the EGA board was never exploited with a real mass market product," says Fischer. "But IBM made more facilities available on the VGA card [than they did on the EGA]. A lot of things can be done [through the adapter]," he adds.

Speed is also an issue. One approach taken by Video Seven Inc., in Fremont, Calif., is the use of video RAM instead of dynamic RAM for display memory. "As the industry moves into high-end machines, '386 machines, the slowness of graphics boards becomes more pronounced and more apparent," according to Shealy. "One of the ways to get around this is to move to VRAMs. VRAMs have built-in shift registers that do the conversion for you. Basically, this speeds up the access time to RAM — that's increased performance." But VRAM is currently quite expensive, and not easy to find. "Cards with VRAM will be priced much higher than other VGA boards," says Lynar. "It [using VRAM] is a valid approach to addressing the video bottleneck problem," says Fischer. □

ECL vs. GaAs chips: Let the clock-speed games begin

Brisk new bipolar designs are catching on. But are they enough to keep GaAs advances at bay? Most speed-hungry users have no doubts

BY VALERIE RICE

The market for very fast logic chips, once confined to esoteric computer systems in the form of TTL chips, has expanded dramatically in recent years to embrace new process technologies — like bipolar ECL and the "alternative" technology gallium arsenide (GaAs) — as well as new customers.

The reasons? Technology marches on, and advances in emitter-coupled logic, including improved density and lower power dissipation; and in digital GaAs, which has been proven to be commercially viable in some applications; have made believers out of skeptics.

Now a new market of speed-hungry users awaits suppliers of these very fast chips, giving breaks to brash start-ups and forcing old-line chip makers and their equipment suppliers to rethink their strategies. And it's a market that could favor U.S. over Japanese suppliers as users like Scientific Computer Systems Inc., fearing dependence on Japanese "competitors," brag about the all-American content of their high-performance systems.

But do those users opt for bipolar? Or are they seduced by new GaAs designs? Despite much warring talk, most of it from GaAs suppliers, there's little contest. GaAs, still wrestling yield, pricing and second-sourcing problems, remains attractive chiefly for applications where speed is the foremost feature. For all other speedsters, ECL does fine.

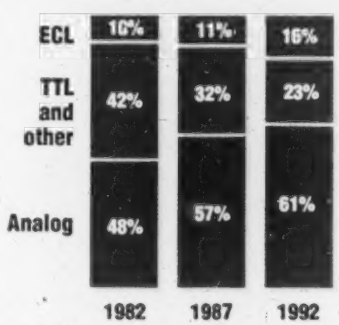
But both ECL and GaAs sectors are teeming with activity. The best example of that activity is the number of start-up companies appearing over the last few years. At least four bipolar start-ups have been founded during the past five years. And 20 GaAs start-ups were begun in the period from 1978 to 1985, according to a study by market research firm Dataquest Inc.

Even the customer base has changed. GaAs, which is so well suited for military markets that it runs the risk of being typecast, has finally clawed its way into the commercial market — and the digital market — it is 100% of the logic in Cray Research Inc.'s latest system, the Cray 3. Bipolar ECL has also found its way out of the old Cray 1, where it was first used, and into very high-end workstations that actually sit on a desktop. Two years ago, that was unheard of.

Gallium gains notwithstanding, silicon lovers can rest assured, at least for awhile. Digital GaAs has a ways to go before it can overtake bipolar ECL.

Bipolar technology trends

Share of bipolar IC market



Total bipolar IC market ($ billions)

$4.6	$10.7	$15

Source: Integrated Circuit Engineering Corp.

ECL's share of the bipolar business is growing as TTL technology is chased by CMOS ASICs

Data from market research firm Integrated Circuit Engineering Inc. shows that the 1987 bipolar market was worth $10.7 billion, of which ECL represented 11%, or roughly $1 billion. The bipolar market is forecast to grow to $15 billion by 1992, with the ECL share increasing to 16%.

In contrast, digital GaAs was only a $35 million market in 1987, according to ICE. It is expected to show hearty growth, however. ICE forecasts the 1992 market to be about $600 million for digital GaAs.

Depending on who's speaking, bipolar versus GaAs is an either/or situation. Soothsayers predict the technologies will learn to peacefully coexist, with each finding its appropriate niche. Naysayers, on the other hand, expect one technology or the other to be obliterated, again depending on who is speaking.

So could GaAs be a real threat to ECL?

Perhaps, says ICE's market research manager William McLean, but it is unlikely to take a big chunk away from the bipolar. "There's been a lot of work in the ECL area," he says. "All the experience, time and effort that has been put into ECL dwarfs GaAs."

GaAs technology has not advanced that quickly, he says, and he does not see a breakthrough on the horizon that will rescue it from its high cost.

No competition

Start-up Bipolar Integrated Technology Inc.'s marketing vice president, Les Soltesz, says definitely "we do not see any sort of competition whatsoever from GaAs. Our application base is made up of companies pushing the state of the art of integration, putting more on a single chip. GaAs can't provide that."

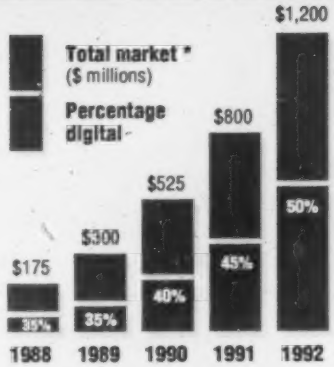
But the GaAs proponents are

equally sure that they can beat ECL at its own game. Or at least start-up Vitesse Semiconductor Corp. says it can.

Vitesse claims that its strategy is to offer users pin-compatible GaAs parts, both gate arrays and standard products, that are equal in price to ECL; equal or better in speed; and have much lower power dissipation. This puts Vitesse directly in competition with giants Motorola Inc. and Hitachi Ltd., as well as start-ups like BIT. But Vitesse executives say that doesn't scare them one bit.

The most likely technical hitches to Vitesse's plans revolve around yield and interconnect issues. One of the largest challenges in digital GaAs has been achieving production yields comparable to those obtained with silicon. The other challenge, experts say, is that while GaAs in a single chip is very fast, GaAs in a gate array above 10,000 gates or so can be slower than bipolar. The high amount of interconnect necessary to link 10,000 gates together slows GaAs down more than bipolar, experts say.

Worldwide GaAs market



* Includes development funding

Source: Integrated Circuit Engineering Corp.

GaAsing up: Twenty GaAs start-ups were founded from 1978 to 1985, and the results are starting to show

Other GaAs companies, like Gigabit Logic Inc., do not claim to be on a collision course with ECL manufacturers. "We can coexist," marketing and sales vice president James Brye claims. "GaAs belongs in a performance niche."

Brye sees GaAs going into two different areas. One is applications that require "blazing speed," described as more speed than can be achieved from using silicon. In those cases, "GaAs technology will displace ECL," he says. The other area is where GaAs can do certain functions that will be "forever out of the scope of bipolar," such as one- or two-gigahertz products for telecommunications.

Triquint Semiconductor Inc. is another GaAs start-up; actually a captive operation for instrument giant Tektronix Inc. that was taken merchant several years ago. Marketing manager Louis Pengue agrees with Brye that GaAs can live in harmony with ECL. "We will replace the ECL bottlenecks, " he says. "One or two chips primarily and the rest will be ECL, especially if they are high volume, jelly bean type parts. I see GaAs as a niche market. There is no way we will push out ECL."

Perhaps the most interesting view of the bipolar-versus-GaAs debate comes from a man who straddles all three fences: bipolar, GaAs and CMOS. T.J. Rodgers, head of CMOS-based Cypress Semiconductor Corp.,

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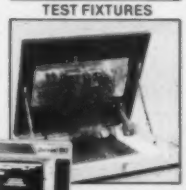

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is also acting president of his bipolar spin-off Aspen Semiconductor Corp., as well as on the board of Vitesse.

"There's no conflict of interest here," Rodgers claims. "In bipolar, I steer them away from making something that could be made out of CMOS, because the CMOS part will prevail. But in some areas bipolar is outperforming CMOS. It has a current advantage that is scalable and maintainable, and you can receive a premium for your effort. GaAs, on the other hand, can do many things ECL can't touch, such as high-frequency telecommunications or military applications. The yields are as good in GaAs, but we have to focus where we have an overwhelming advantage."

Rodgers warns that GaAs won't take business away from identical bipolar parts with the same margins.

In the bipolar ECL market where a handful of large companies own 70% of the market, do start-ups have a chance?

Certainly, claim the start-ups, and old-time start-up BIT may be proof. The company has major design wins with Sun Microsystems Inc., Alliant and Apollo Computer Inc., Soltesz claims, and says the company is living proof that bipolar isn't dead.

But although Soltesz is justifiably proud of his large customers, there are some customers who might be more leery of doing business with a start-up. One supercomputer manufacturer that evaluated BIT as a supplier questions that company's ability to supply sufficient parts, says a manager who preferred not to be named.

And Sun Microsystems' microprocessor marketing manager, Steve Diamond, says that his company is open to hearing from other bipolar companies who would be interested in licensing Sun's Sparc RISC chip architecture, something which could put a dent in BIT's sales.

Clearly, the concerns surrounding doing business with a start-up aren't unique to BIT.

For many chip users, speed is everything. Convex Computer Corp., for example, recently switched from using TTL to ECL, because the ECL parts gave the company faster clock rates and higher densities, says engineering vice president and cofounder Steve Wallach.

Wallach adds that designing with ECL makes it easier in the future to switch to GaAs. But he cautions that GaAs has a long road to travel before it can be truly competitive with ECL. Density problems and high cost, coupled with a real lack of second sourcing, make it a difficult choice today unless, as he says, "you're a company like Cray Research."

Cray went with GaAs in its Cray 3, a spokesman says, mostly because super-designer Seymour Cray felt that there wasn't too much power left in silicon. All of the logic in the Cray 3 is GaAs, the spokesman says, although he notes that the company's new machine, the Y-MP, which is ECL-based, has not reached the limits of ECL technology.

Sun seems determined to cover all the technology bases, according to Diamond. The company is currently evaluating GaAs as a possible medium for its Sparc architecture. □

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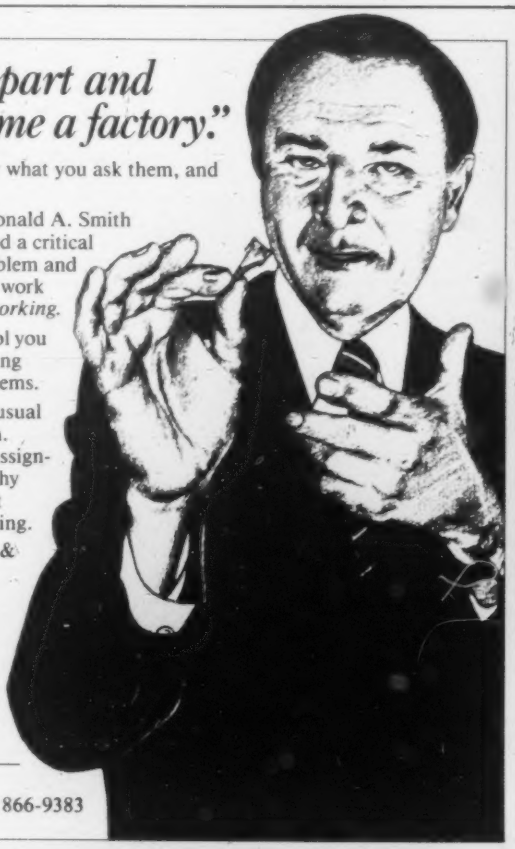

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Resistive components: Not so lonely, not too lowly

Guess where the leading manufacturer of resistors is located. In the Far East? Guess again

It sounds next to impossible for a United States-based manufacturer to be first in any segment of the components market. After all, as recently as 1984, Texas Instruments Inc. was No. 1 in semiconductors. Since then, it has relinquished the prime position to Nippon Electric Co. Semiconductors are only the most recent example of a trend that started long ago with passive components. So, it must be very difficult for U.S. makers of that most humble of passives, the lowly resistor, to be first. Right?

Wrong. Bourns Inc. is the largest maker of resistive trimmers in the world, a feat that places the Riverside, Calif., company automatically as the No. 1 maker of variable resistors. And Bourns is not alone. Vishay Intertechnology Inc., of Malvern, Pa., is first in fixed resistors. But, since Vishay sells more resistive components than Bourns does, it can also claim the No. 1 spot for resistors in the United States — and probably the world.

Vishay's president, Felix Zandman, does not overtly make such claims for the company he founded 27 years ago. So one adds $75 million in 1987 sales worldwide by the recently acquired film resistor operations from Corning Glass Works; plus $130 million in film resistors and networks from half-owned Dale Electronics, which becomes wholly owned as of next month; to Vishay's own $25 million worth of high-precision foil resistors. This amounts to a total of $230 million, all in fixed resistors.

What vaulted Vishay to the top are the acquisitions and divestitures that have taken place in this market. This marks quite a change from the days when, riding on the dominance of its fixed composition resistors, Allen-Bradley Co. was the undisputed leader. But AB is still perceived as the leading brand among our readers, according to the latest study of brand awareness and brand preference by ELECTRONIC BUSINESS magazine. The reason may be that, even though AB is now a subsidiary of Rockwell International Corp., it retains its identity in components. Dale Electronics, formerly a Lionel company and now part of Vishay, tied with Bourns for second place in brand preference. But other manufacturers have not been so fortunate. International Resistive Company Inc.'s brand image in our study is split between its former owner TRW Inc., and the "new" old name it had before TRW bought it, even though IRC is now part of a larger entity in resistors, namely Crystalate Holdings Plc.

Consolidation in the resistor market has helped the distributor, says Avnet Electronic Marketing Group chairman Tony Hamilton. More than 30% of resistor sales go through industrial distribution. Hamilton thinks that resistor sales by distribution will grow 10% in 1988. Zandman has the same forecast for Vishay's sales. So far, he has been conservative.

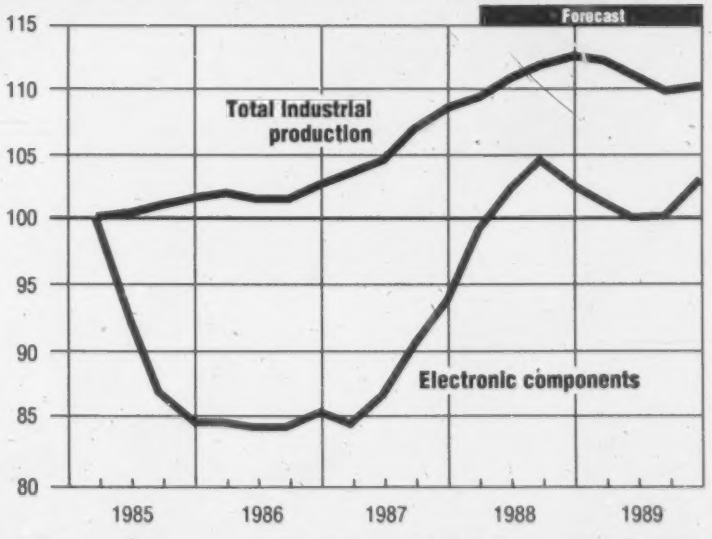
The Electronic Industries Association reports that U.S. factory sales of components of all types, active and passive, jumped 23% in the first quarter of this year versus a year ago. Most of the credit for that increase goes to semiconductor sales which, according to the Semiconductor Industry Association, grew by almost 30% in the same quarter. This still leaves enough room for components other than semiconductors to have enjoyed a healthy increase in sales. The SIA expects that U.S. sales will end 1988 ahead of 1987 by 26%, and many passive components manufacturers hope to do almost as well.

Based on the Federal Reserve Board's figures for the U.S. production (instead of sales) of components of all types, which show an increase of 17% for the first quarter, Cahners' senior economist Elizabeth Baatz forecasts a slight easing to 15% for the whole year, followed by no production growth in 1989. About two-thirds of Vishay's resistive components production is in this country, but Zandman makes no forecast for next year. "My crystal ball doesn't extend that far," he says.

ALBERTO SOCOLOVSKY

Electronic component production index

Quarterly averages, 1st quarter 1985 = 100, seasonally adjusted

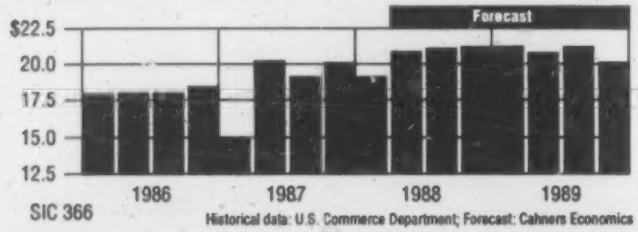


SIC 367

Historical data: Federal Reserve Board; Forecast: Cahners Economics

Communication equipment — New orders

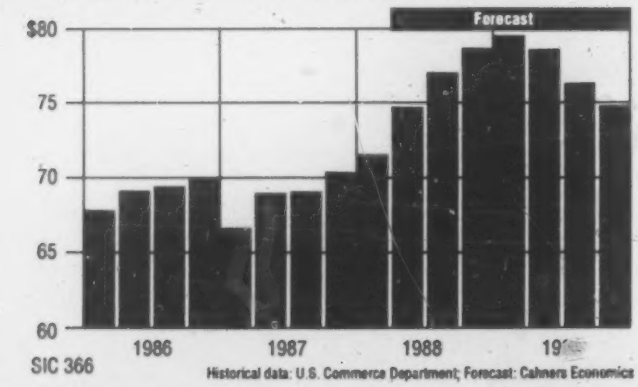
Quarterly totals, seasonally adjusted ($ billions)



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

Communication equipment — Unfilled orders

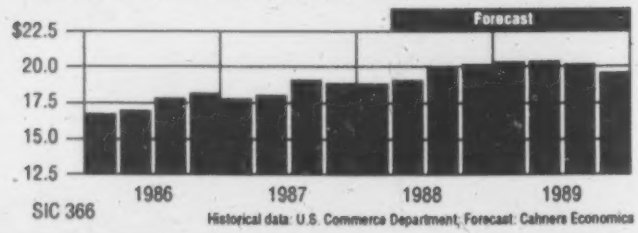
End-of-quarter totals, seasonally adjusted ($ billions)



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

Communication equipment — Shipments

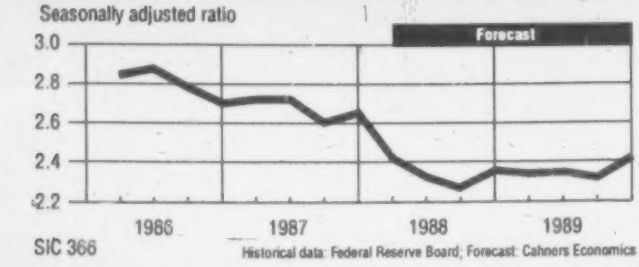
Quarterly totals, seasonally adjusted ($ billions)



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

Communication equipment — Inventory-to-shipments

Seasonally adjusted ratio



Historical data: Federal Reserve Board; Forecast: Cahners Economics

Communication equipment slows

Unlike the rest of the electronics market, communication equipment manufacturers face an entirely unique set of circumstances in 1988. One reason this is so: almost half of all communication equipment shipped from U.S. factories last year was sent to the defense department. In 1980, less than a third of all communication equipment shipped was classified as "defense."

The upshot? With such a heavy reliance on the defense budget, communication equipment makers are bound to suffer from a slowdown in growth. Defense procurement budgets are projected to fall at least 1.4% in the 1988 fiscal year under the administration's current budget. And that decline doesn't even take into account the shrinking budget due to inflation.

In 1987, defense orders for communication equipment fell 4% on the heels of an 11% drop in 1986. Commercial orders have fared better, growing 7% in 1987 and 2% the year before.

Early evidence for 1988 shows a weak recovery. New orders for all communication equipment fell 5% from the fourth quarter of 1987 to the first quarter of 1988. But the strong upturn in new orders at the end of last year means this decline is relatively modest; new orders remain 28% above year-ago levels. Shipments, however, remained flat.

Of all the statistics reported on the communication equipment industry by the U.S. Commerce Department, perhaps the most disturbing is backlogs. Ever since mid-1985, the rate of growth of backlogs has been steadily and noticeably slowing down. Backlogs grew at a 25% rate in mid-1985, slowed to 9% growth by the end of 1986, and inched up only 0.2% by the end of last year.

Offsetting the disturbing trends in backlogs, communication equipment manufacturers have been doing a great job of keeping inventory in control. Inventory-to-shipments ratios for this industry plummeted to 2.55 last December, the lowest since 1979. Early evidence for 1988 shows inventory rising faster than shipments, but critical imbalances are unlikely.

A slowdown in backlogs is probably hitting defense manufacturers hardest. As production eats away at those healthy backlogs, a production cutback in 1989 is probable.

As defense demand withers, Cahners Economics' forecast for communication equipment depends largely on a rebound in commercial orders. Orders are projected to grow 10.6% in 1988 and fall 0.2% in 1989. Shipments are expected to rise 5.6% this year and 3.2% next year.